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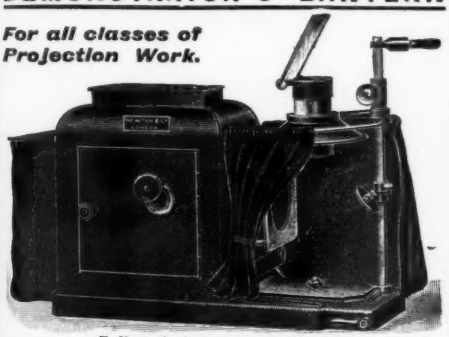

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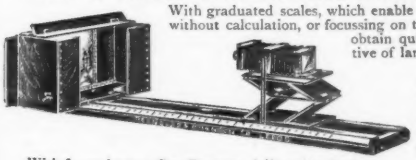

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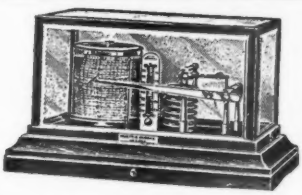

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UNIVERSITY OF LONDON.

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The Senate of the University of London invite applications for the GRAHAM SCHOLARSHIP in PATHOLOGY, value £400 per annum for two years, founded under the will of the late Dr. Charles Graham to enable a "young man to continue his pathological researches, and at the same time to secure his services to the School of Advanced Medical Studies connected with University College Hospital as a Teacher under the direction of the Professor of Pathology."

The successful candidate will be expected to take up the Scholarship as early as possible in the new year. Intending applicants who desire fuller information of the conditions on which the Scholarship will be held may call personally on the Professor of Pathology, University College Hospital Medical School, W.C. 1. The Scholarship is in no way restricted to students either of University College Hospital Medical School or any other Medical School of the University of London.

Applications, addressed to the PRINCIPAL OFFICER, University of London, South Kensington, S.W. 7, must (*a*) be accompanied by the names of not more than three references, one at least of which should be the name of some Professor, Lecturer, or Teacher of the University or College in which the candidate has conducted his studies in Pathology, (*b*) state the research upon which the applicant proposes to work, and (*c*) be received *not later than the first post on Monday, January 17*, 1921. Envelopes should be marked "Graham Scholarship."

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UNIVERSITY OF LONDON.

GALTON LABORATORY.

A Course of Ten Popular Lectures on "THE PRESENT STATE OF OUR KNOWLEDGE OF THE SCIENCE OF NATIONAL EUGENICS" will be given by Professor KARL PEARSON, F.R.S., at University College, on Wednesdays at 8 p.m., beginning on January 19, 1921.

(1) The Definition, Scope, and Methods of the Science of Eugenics; (2) Man, his Characteristics due to Past History; (3) Natural and Artificial Selection; (4) Heredity of Physical Characters in Man; (5) Heredity of Mental Characters in Man; (6) Heredity of Pathological Characters in Man; (7) Nature and Nurture; (8) Relative Intensity of Factors influencing the Infant; (9) Relative Intensity of Factors influencing the Child; (10) Bearing of the Results reached on National Fitness and Moral Standards, and Legislative Possibilities.

Fee for the Course, £1 1s. Fee to Teachers in the London County Council area, 10s. 6d. As only a limited number of tickets can be issued for the Course, early application should be made to the SECRETARY, Galton Laboratory, University College, Gower Street, W.C. 1.

WALTER W. SETON, M.A. D.Lit., F.S.A.,
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University College, London.

UNIVERSITY OF LONDON.

ADVANCED LECTURES IN PHYSIOLOGY.

A course of Eight Lectures on "THE PHYSIOLOGY OF THE EMBRYO, FŒTUS, AND NEWLY-BORN" will be given by Professor M. S. PEMBREY, M.A., M.D., B.Ch., in the Physiological Theatre, Guy's Hospital, S.E., on Thursdays, January 13, 20, 27, February 3, 10, 17, 24, and March 3, 1921, at 4.30 p.m. Admission free, without ticket.

(Note.—The Course of Lectures arranged to be given by Mr. J. A. Gardner has been postponed.)

EDWIN DELLER, Academic Registrar.

EGYPTIAN GOVERNMENT SCHOOL OF MEDICINE.

The post of PROFESSOR of CHEMISTRY is vacant owing to the appointment of the present holder as Professor of Chemistry in the University of London.

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Pension and leave are calculated under the rules governing the rest of the Egyptian Civil Service.

Applications, with personal references and details of experience in teaching and research (five copies of each document), should be addressed in the first instance to the DIRECTOR, Egyptian Educational Mission, 28 Victoria Street, Westminster, S.W. 1, by whom they will be forwarded to the Selection Board formed in England. No communications should be addressed to Cairo.

Information as to conditions of tenure can be obtained on application.

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Applications must be made before January 31, 1921.

TECHNICAL INSTITUTE, WALTHAMSTOW.

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UNIVERSITY OF CAPE TOWN.

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Applications are hereby invited for the post of LECTURER on PHONETICS in the School of African Life and Languages at the University of Cape Town. The Lecturer may be asked to specialise in (i) Zulu and Xosa, or (ii) Sechuana, or (iii) Sesuto. The salary is £450 p.a., rising by annual increments of £25 p.a. to a maximum of £650 p.a., with a temporary bonus according to the Government scale of war allowance (at present £126 p.a. for a married man).

The Lecturer must become a member of the Government Teachers' Superannuation Fund.

Applications, together with copies of testimonials, all in duplicate, should be lodged, not later than January 31, 1921, with the SECRETARY, Office of the High Commissioner for the Union of South Africa, 32 Victoria Street, Westminster, S.W. 1, from whom further particulars may be obtained.

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The Nile, Egypt, and the Sudan.

THE latest publication of the Public Works Ministry of Egypt is of more than usual interest, for it not only appears at a time when work is being resumed after being stopped, or at least largely restricted, during the war, but it also sets forth a large collection of data relating to projects which have met with criticism in some quarters during the last three years. A year ago the Nile Projects Commission was appointed to report upon the physical data upon which the engineering plans were based, and this Commission has now unanimously accepted Sir Murdoch MacDonald's evidence and approved his designs for the series of irrigation works described in the report before us.

A small amount of rain falls annually on the Mediterranean shore of Egypt, but this diminishes rapidly as we go southwards, so that it is of no value to agriculture, except for the winter crops raised by nomad tribes west of Alexandria. All the water that the increasingly intensive cultivation of Egypt demands must be supplied by the Nile, and recent surveys have established that there are about 7½ million acres which can be perennially cultivated if the necessary water is forthcoming at all seasons.

Fed by the summer rains on the Abyssinian tableland, the Nile begins to rise in Egypt in June, and reaches its maximum level in September, after which it falls slowly, the contribution of the White Nile delaying the reduction of the levels to a very appreciable extent. The task, therefore, of those in whose charge the control of the Nile water rests is to utilise the surplus water of the flood or of the river in the early stages of its fall in order to supplement the supply in the early summer, when the discharge is wholly inadequate to meet the demands of agriculture. From 1886, the earliest year for which statistics of the cultivated areas are available, there has been a steady increase in the area perennially cultivated, until now the area is greater by one-third, or more than a million feddans,[2] than it was in 1886. As some land is double-cropped, the total crop area now requiring water is somewhat more than 7½ million feddans.

While this rapid extension of the area under cultivation has been taking place, the population of Egypt has been increasing at a notable rate, and while it stood at 7½ millions in 1886, it numbered 12¾ millions in 1917; consequently, the cultivated area per head of population, which in 1886 was 0·65 feddan, in 1917 was 0·42 feddan, and the crop area had fallen from 0·89 feddan to 0·60 feddan. Thus one result of an improved administration of the country has been to increase the demands upon its irrigation in much the same proportion as new projects could be designed and carried out.

For the first decade after the reconquest of the Sudan in 1898 the lands bordering on the Nile and those areas where the summer rains made cultivation practicable sufficed for the support of the population which remained after fifteen years of Dervish rule. In 1903 experiments were made to test the feasibility of producing, with the aid of irrigation, crops suitable for export, such as wheat, sugar, and cotton; and the area which might be so cultivated in the Sudan was fixed at 10,000 feddans, an amount which was increased to 20,000 feddans when the Aswan Dam had been raised to its full height. It was now evident that the Sudan could in time utilise a much larger area of the fertile Gezira, the tract between the Blue and White Niles, if sufficient water could be taken from the Nile without prejudicing the supply required by Egypt; and the projects now described, which have been in preparation since before the war, have been designed to supply water for an area of 300,000 feddans in the Sudan, while safeguarding at the same time Egypt's requirements.

Accurate gauging of the volume discharged by the Nile at all stages was of the first importance,

[1] "Nile Control." By Sir Murdoch MacDonald, Adviser, Ministry of Public Works, Egypt. (Cairo: Government Press, 1920.) Price 20 P.T.

[2] A feddan is equivalent to 1·038 acres.

and much criticism has been directed against the tables of discharge which the Public Works Ministry has published; but there are no valid grounds whatever for doubting their correctness, and the accounts given of the rating of current-meters in this report, the accuracy of the discharges measured with them, and the method of measuring the volume discharged through the sluices of the Aswan Dam, show that the greatest care has been taken to obtain as high an accuracy as possible. The report of the Nile Projects Commission, which has just been issued, affords a complete vindication of the accuracy of these measurements.

In the early days of the British occupation of Egypt the reorganisation of the irrigation of the country was recognised as being of the first importance, and every improvement that was achieved produced large returns in the shape of increased economic prosperity. But as the margin of possible improvement grew narrower with each advance, greater precision of measurement became necessary, and for some years a special branch of the Public Works Ministry has been engaged upon the scientific investigation of all the problems of Nile hydrography. The necessity for this was clearly shown in the exceptionally low flood of 1913, and in the consequent deficiency in the supply in the following spring and summer. The volume discharged by the river in this exceptional year was only 41,000 million cubic metres, whereas the total requirements of Egypt and the Sudan by 1955 are estimated to reach 56,000 million, so that additional works must be constructed, even though such an extraordinarily low flood occurs but rarely. The Blue and White Niles, from which this additional supply must be obtained, differ fundamentally in their hydrographic character. The Blue Nile, with a comparatively short course of approximately 1500 kilometres and a fall of 1400 metres, carries a heavily silt-laden flood past Khartum which may reach and even exceed 9000 cubic metres a second. The White Nile, on the other hand, has deposited most of its load in the marsh region of its upper reaches, or on the plains of the Sobat River, so that its waters are clear and can be stored in a reservoir; also the shallow valley of the White Nile, with its exceedingly low slope, allows a very large volume to be held up by a work of moderate height.

The present scheme provides both for a dam across the White Nile valley at a short distance upstream of Khartoum, and for a dam on the Blue Nile near Sennar. The site selected for the White Nile dam is at Gebel Aulia, 45 kilometres upstream of Khartoum, where the valley is wide and shallow. A continuous masonry dam 5 kilometres long and further extended by 1½ kilometres of an earthen dam with a masonry core wall will hold up the waters of the White Nile to a height of 8 metres above summer river level, and to 9·5 metres in years of high flood; it will thus provide an additional 4000 million cubic metres of water for the development of Egyptian agriculture and for the reclamation of the northern shore of the Delta; it will also act as a protection work in high floods by holding up water until the crest of the Blue Nile flood has passed and the White Nile water can be released without danger. Evaporation over the surface of the reservoir which will be formed by the dam will be large, for the maximum area is 540 square kilometres, and observations show that it will amount to 11 mm. per day in April, and to 2·4 mm. in the rainy season when allowance has been made for the rainfall. The loss by absorption over the area of the reservoir must also be considerable, and 1 cubic metre of water per square metre of surface has been allowed for this.

For meeting the requirements of the Sudan, a dam is proposed on the Blue Nile near Sennar, and the one which has been designed will be a solid masonry structure of granite, with sluices and spillways sufficient to discharge 15,000 cubic metres per second. By the control which this dam will afford, such water as is needed for use in the Gezira can be withdrawn from the Blue Nile from July 15 to January 18, after which the reservoir upstream of the dam will supply the further requirements of the Sudan in order that the water flowing in the Blue Nile may pass on to Egypt without diminution.

The data relating to both these schemes are set out fully in the report, from which the amount of water which is required for the agricultural development of different regions at each season can be seen, and the provision for meeting these requirements by means of the storage and control provided by the dams at Aswan, Gebel Aulia, and Sennar can be readily examined.

Some subsidiary works will be needed, and one of these is a barrage at Naga Hamadi, in Upper Egypt. One effect of filling the new storage reservoir by means of the White Nile dam will be to lower slightly the maximum of the flood at Aswan, and, consequently, to make the watering of the higher lands of Upper Egypt more difficult. The conversion of land in this part of

Egypt from basin to the perennial system of irrigation is now due, and to meet these needs this barrage will have to be constructed.

Besides these works which are about to be constructed on the Blue and White Niles, two other projects of which the need in the future can be foreseen to complete the control of the Nile supply are briefly discussed. One of these is the Lake Albert dam, by means of which it is proposed to hold up a reserve store of water in the Albert Lake, which will be conveyed to the White Nile by a channel or channels so planned as to avoid the loss of water which now takes place in wide, shallow valleys where the sadd marshes are situated. The other scheme, which is even more briefly outlined, is the provision of a dam on the upper reaches of the Blue Nile to store 7000 million cubic metres of water, of which part would be kept as a permanent reserve in case of low floods, and the balance used to irrigate the cotton crop on one-third of a million feddan area in the Sudan. Nothing has yet been done on either of these projects, and no details are published in the report; they are only indicated as works which must eventually be undertaken to provide the necessary water for agriculture in arid and semi-arid areas of the Nile basin.

The report contains a large amount of valuable information on the utilisation of water under the special conditions which prevail in Egypt. The requirements of agriculture are fully stated by the responsible authorities of Egypt and the Sudan; detailed estimates of the amount of water which is available at various seasons are also given as the result of a long series of measurements which have been made in recent years. This collection of hydrographical data brings those which were previously available up to date, and supplements them by much information of greater accuracy on which the present projects have been based.

With a rapidly increasing population the occasional occurrence of such disastrously low floods as that of 1913 has carefully to be guarded against; on the other hand, the growing demands of cultivators in Egypt, and the needs of the Sudan, which will be increasing for years to come, call for the most careful investigation of the hydrography of the Nile, for, while the supply of water is shown to be sufficient to meet all anticipated requirements, this can be done only by a full control of the supply and a careful regulation at all seasons by suitable works.

Poynting's Scientific Papers.

Collected Scientific Papers. By Prof. J. H. Poynting. Pp. xxxii+768. (Cambridge: At the University Press, 1920.) Price 37*s.* 6*d.* net.

THESE papers make a stately volume of considerably more than 700 pages, and our thanks are due to the editors, Mr. Guy Barlow and Dr. Shakespear, for the ability with which they have performed their work, a work which, as old pupils of Poynting, must have been to them a labour of love. The volume contains an excellent portrait, and the type, paper, and binding are worthy of the Cambridge University Press. I think everyone, even though he may have thought himself well acquainted with Poynting's work, will find here something which he sees for the first time, for the volume includes not only papers from such normal sources as the Transactions and Proceedings of the Royal Society and the *Philosophical Magazine*, but also others from the *India Rubber Journal*, the *Hibbert Journal*, the "Encyclopædia of Biblical Literature," the *Mason College Magazine*, and the *Inquirer*. In addition to the classical papers on the flow of energy in the electromagnetic field, on the pressure of light, and on the density of the earth, there are others on the drunkenness statistics of the large towns, on the fluctuations in the price of wheat, on the experiences of one who overtook the waves of light, a criticism of Herbert Spencer's "First Principles," and a paper on physical law and life. To those who knew Poynting, these informal papers have a special charm, for they will find in them much that will recall memories of long-past talks; they recall his quiet humour, the freshness of his views, his courtesy in debate, his dread of saying or doing anything that could hurt the feelings of anyone who did not hold his own views on the point at issue. Among the seventy papers in this book, there are not more than two or three that could be called controversial, and it is characteristic of these that he criticises his opponent as if he loved him; and, even when the author under notice has laid himself more than usually open to criticism, Poynting is not content with pointing out the unsoundness of his statements; he suggests that he must really have meant something else, something much more reasonable.

Another feature of the book is that running throughout the papers is a view of the philosophy of physics which is now very prevalent, but which Poynting was one of the first in this country to adopt. This view is summarised in the paper on "Physical Law and Life"; and though this paper

was not published until 1903, he had then held the views expressed in the following quotation for a long time:—

"I have no doubt whatever that our ultimate aim must be to describe the sensible in terms of the sensible. But I see, too, what gulfs there are still separating one part of our knowledge from another, and I see no harm in throwing temporary bridges of hypotheses across these detached gulfs to connect what would otherwise be detached regions. They allow us to pass to and fro with ease, and have been, and are, of enormous help to us in our exploration of Nature. But we must bear in mind that we may have many types of connecting bridge, many forms of hypothesis equally serviceable, all perhaps to be broken down and abandoned when we have filled in the gulfs which they crossed, and have made firm roadways built of sensible fact."

As another illustration of the modernness of his point of view, I may take a sentence from his address as president of Section A at the meeting of the British Association at Dover in 1899:—

"Another illustration of the illegitimate use of our hypothesis as it appears to me is the attempt to find in the ether a fixed datum for the measurement of material velocities and accelerations, a something in which we can draw our co-ordinate axes so that they will never turn or bend. . . . We could only fix positions and directions in the ether by buoying them with matter. We know nothing of the ether except by its effects on matter, and, after all, it would be the material buoys which would fix the position, and not the ether in which they float."

Poynting's scientific work concentrated in the main on three subjects: the flow of energy in the electromagnetic field, researches on gravity, and on the pressure of light. It is by the first of these that he is perhaps most widely known, and with which "Poynting's vector" will always associate his name. It was Poynting who introduced the idea that the energy in the electromagnetic field flows in the direction of a vector now known as "Poynting's vector," which is at right angles to both the electric and the magnetic forces, the rate of flow being proportional to the product of these two forces and the sine of the angle between them. Thus, whenever there are both electric and magnetic forces, there is flow of energy unless the two forces are in the same direction, and wherever there is flow of energy there are both electric and magnetic forces.

The importance we attach to this result will depend upon the view we take of the localisation and identification of energy. If we confine ourselves to the dynamics of a system of bodies acted upon by assigned forces, we may regard the kinetic and potential energies of the system as names for certain functions of the velocities and co-ordinates of the bodies which satisfy a sufficient number of equations to enable the co-ordinates of the system to be determined at any time if the co-ordinates and velocities at some previous time are known. The idea of localisation of energy is foreign to this point of view, for the amount of kinetic energy possessed by any member of the system will depend upon the choice of axes to which the velocities are referred, while when we regard the potential energy of two charges separated by a distance r as $-ee'/r$, the idea of localisation of energy is unmeaning and immaterial. When, however, we discard the idea of action at a distance, and regard the space between bodies as the seat of the influences they exert on each other, the question of the localisation of energy at once becomes prominent. Thus, to take a definite case, we may regard all energy as molecular in structure, and made up of a large number of units, all the units possessing the same amount of energy, and the energy of each unit remaining unchanged as the unit moves about. Thus the amount of energy in any region is proportional to the number of units of energy in that region, and changes in this amount are due to the motion into or out of this region of units of energy. From these points of view the motion of these units is what governs the behaviour of the system, and the flow of these units is represented by Poynting's vector. Poynting's work on the pressure of light and his determinations of the density of the earth by an ordinary balance are great tributes to his skill and insight as an experimenter. The method with the ordinary balance is, as he himself acknowledges, inferior to that employed by Boys, and yet Poynting was able to get, by care and skill, a result comparable in accuracy with that obtained by the better method.

Poynting's experimental skill and his power of devising simple apparatus which could be made in the laboratory and yet give results of the highest accuracy were quite remarkable, and the simplicity of the means by which he got his results was not surpassed either by Stokes or by the late Lord Rayleigh.

To read through everything that a man has published during forty years of scientific work, extending over a period remarkable for new discoveries and the introduction of new ideas, is a severe test for his reputation; it might be expected that much would seem musty and out of date; this, however, is not so with Poynting's papers, for in them there is little or nothing which in any way conflicts with modern ideas.

Poynting's researches, important as they are, form but a part of his life's work. He was a very successful teacher, and as professor of physics at Mason's College from its foundation he created and developed the flourishing school of physics at the University of Birmingham. He took his full share of the large amount of business and organisation required to carry on the work of his university and the scientific societies with which he was connected, and as a magistrate he took part in the civic life of Birmingham. Everyone who met him in these capacities found him the most delightful and courteous of colleagues, while to many he was the beloved and valued friend. J. J. THOMSON.

Scottish County Geographies.

(1) *Banff and District.* By Allan Edward Mahood. Edited by Dr. E. I. Spriggs. Pp. xvi + 388. (Banff: *The Banffshire Journal,* Ltd., 1919.) Price 10*s.* 6*d.*

(2) *Orkney and Shetland.* By J. G. F. Moodie Heddle and T. Mainland. Pp. xii + 167. (Cambridge: At the University Press, 1920.) Price 4*s.* 6*d.* net.

(3) *Caithness and Sutherland.* By H. F. Campbell. Pp. ix + 168. (Cambridge: At the University Press, 1920.) Price 4*s.* 6*d.* net.

(4) *Kirkcudbrightshire and Wigtownshire.* By William Learmonth. Pp. ix + 149. (Cambridge: At the University Press, 1920.) Price 4*s.* 6*d.* net.

(5) *Dumbartonshire.* By Dr. F. Mort. Pp. viii + 155. (Cambridge: At the University Press, 1920.) Price 4*s.* 6*d.* net.

(1) DR. MAHOOD'S "Banff" belongs to the best class of local guide-book. It is the result of a careful study of the area by a number of enthusiastic students; the bulk of the material has been collected by Dr. Mahood, of Duff House Hospital. Chapters have been contributed by various local authorities, and the whole has been condensed and edited by Dr. E. I. Spriggs, and its stores of information are rendered accessible by an excellent index. The book is a compendium of the geography, history, and antiquities of the district, and should add greatly to the profitable enjoyment of a stay there by any intelligent visitor; and, as it gives practical guidance to the special points of interest, it should stimulate the study of the local archæology and natural history.

The walks around Banff are classified according to their length, and the programme of longer excursions refers to the numerous antiquities and to such features as the musical sands, the dunes of Culbin, and the remarkable southerly deflection of the plumb-line at Cowhythe, which would indicate a position nearly a fifth of a mile in error. Banff Museum is rich in local material, and the chapter on it is a useful introduction to the local archæology and history. Banff was the home of Thomas Edwards, the self-made naturalist with the Smiles-made reputation, who, amongst other contributions to science, demonstrated that the shell beds on the 25-ft. raised beach at Boyndie is a Neolithic kitchen-midden.

The geology of the area includes much of interest, and special attention has been recently directed to it by Mackie's discovery of the plant-bearing cherts of Rhynie, which have been proved by the researches of Kidston and Lang to be the oldest known land flora, and to contain, exquisitely preserved, the plants of the period when land was being first clothed with vegetation. The discovery of this flora is the most epoch-making in palæobotany in recent years. The account of the geology is well up to date; it recognises the Old Red Sandstone as a river-made deposit, but that view need not have been assigned to America, as it had been previously advanced in this country. A remark on the work of Prof. Jehu and D. Campbell on the Highland Border Series may be misunderstood as implying that some of the Highland schists have been thus proved to be Lower Palæozoic, whereas that work strongly strengthens the case for the pre-Palæozoic age of those schists.

(2–5) The volumes of the Cambridge University County Series suffer in contrast with that on Banff by the absence of references, as even a short bibliography would be of great assistance to the students for whom these admirable manuals would be of special service. Moreover, the one author deals with all branches of the subject—history, geography, archæology, ethnology, geology, natural history, and economics—and has to write on some questions with which he is not fully familiar. Consistency between the manuals and complete accuracy are possible only by editorial supervision. In this series the authors appear to be given entire independence provided they conform to the prescribed plan.

A student who turns to these volumes to compare the evidence on some question from different parts of Scotland finds puzzling inconsistencies. Thus the circular megalithic towers known as brochs, the most remarkable of Scottish antiquities, are attributed in the account of those in Caithness and Sutherland to the early Iron age, and therefore to be pre-Roman; whereas the volume on Orkney adopts the older and less probable theory that they were built as shelters against

Norse vikings, and would therefore be post-Roman. The advantage the volumes would gain from expert supervision may be illustrated by the sections on geology. Thus the Old Red Sandstone is still attributed in the volumes on Orkney and Shetland and on Caithness and Sutherland to lakes, whereas the work on Banff adopts the fluviatile explanation. The table of the geological succession in Caithness and Sutherland (pp. 13–15) states that the Upper Trias is absent from England, and that the Upper Cretaceous consists of "chalk and ware," whatever "ware" may be. The summary of the Carboniferous suggests an erroneous correlation of the English and Scottish divisions; the metamorphic rocks and schists are described as Silurian and Ordovician, and as younger than the Cambrian quartzites; while the discovery of Olonellus in beds above the Torridon Sandstone did not "fix the age of the Cambrian," but fixed those beds as Cambrian. The geological map of Kirkcudbrightshire and Wigtownshire omits the Permian of Loch Ryan, and marks the Permian Sandstones west of Dumfries as "blown sand and alluvium." The rainfall maps of Scotland in different volumes present marked differences in fact.

The four new volumes cover areas representative of the chief geographical types in Scotland—the highlands, the industrial localities of the Midland Valley, and the agricultural districts of the southern uplands—and the authors express clearly the characteristic features of the districts.

The Orkneys and Shetlands are the most exceptional area in the British Isles, which is differentiated by geographical structure, by the far northern position which led to the occasional visits of walrus until the destruction of the Spitsbergen herds, and by the Norse influence to which St. Magnus Cathedral is a striking witness. The population is pure Norse, except for the modern immigration of lowland Scots. The archipelagoes are graphically described by Messrs. Heddle and Mainland.

The recent story of Sutherland and Caithness is one of the saddest in the British Isles. Sutherland is the fifth in size of Scottish counties, and has the sparsest population of any British county. Its population reached its maximum in 1851, and that of Caithness continued to increase until 1861. There was a slight decline until 1871; then with the great extension of the deer forests followed swift and steady decline. Mr. Campbell describes Sutherland as "a desolate wilderness," and says that "one can behold in every direction miles upon miles of country destitute of any sign of human occupation." One result of the depopulation is the increasing difficulty in administration. The outlay on the roads, according to Mr. Campbell (p. 149), now amounts to an eighth of the total rental of the county. Roads suitable for local needs are quite unable to withstand motor traffic, and the upkeep of 500 miles of road at modern standards is beyond the local resources. The financial problems of the county are still unsolved.

The Galloway country, including Kirkcudbrightshire and Wigtownshire, the two southernmost counties in Scotland, presents problems of a different order. The one industry is farming, and mainly dairying; it is the home of the famous Galloway cattle. Farming has been greatly improved by co-operative systems, of which two local varieties are kaneing and bowing. In both the farmer provides land, stock, equipment, and fodder; labour is supplied by his associates, who take the produce and pay for the use of the cows, the kaner in cheese, and the bower in cash. The development of central butter and cream factories, which pay the farmers on the basis of the quantity of butter-fat in the milk supplied, is a more familiar co-operative method, and is proving very helpful.

The volume on Dumbartonshire, by Dr. F. Mort, is most attractively written, and especially good on the physical geography, although that subject is unusually difficult, as the county consists of three very dissimilar areas. It is part of the district known as "the Lennox," and it would have made a more natural geographical unit if it had been combined with Stirlingshire. The western part is an irregular strip of land running across the grain of the country, and its structure can be understood only by reference to the adjacent counties. The most important parts are that along the north bank of the Clyde from Loch Lomond to the western suburbs of Glasgow, and the detached eastern portion which extends south of the Kelvin further east than Stirling. It is owing to the industrial activity of these two areas that the population of the county, in spite of its sparseness in the rest, is fifty-seven times as dense as that of Sutherland, and has been growing at an accelerated rate from the decade when the Highland counties began their decline.

Dr. Mort discusses the proposed Forth-Clyde Ship Canal, and though the text refers to the Kelvin Valley route, which is that regarded with most favour in Glasgow, the only route marked on the sketch-map as for a ship canal is that through the Forth Valley. With present costs of labour and material, the estimate quoted would be quite inadequate, and a canal large enough to fulfil its proposed functions is probably at present financially impracticable. J. W. GREGORY.

Conifers.

Conifers and their Characteristics. By Charles Coltman-Rogers. Pp. xiii + 333. (London: John Murray, 1920.) Price 21*s.* net.

CONIFERS, like ferns, stove-plants, orchids, alpines, and the ignoble carpet-bedding, have had their high tide of popularity. The fashion for them owed its origin chiefly to the work of the collectors Jeffrey and William Lobb in western North America in the middle of last century, and to that of John Gould Veitch in Japan in the early "sixties." From these areas, especially the former, our gardens have obtained their noblest conifers. We are told that, from fifty to seventy years ago, so keen was the desire to plant them that many beautiful flowering trees were destroyed to provide the necessary space, and that gardens in general lost much of their brightness and seasonal charm by the displacement of deciduous trees in favour of the heavier, gloomy, unchanging conifers. Inevitably, the craze came to an end, for a good proportion of them were found to need particular conditions which many localities where they were planted did not provide; and there is no more distressing object in the garden than a sickly conifer. In course of time the pendulum swung so much in the opposite direction that conifers in recent years have been overmuch neglected.

To one who contemplates a serious and exhaustive study of the group, Mr. Coltman-Rogers's book cannot be regarded as anything more than a *hors d'œuvre*; but it is admirably adapted to stimulate a budding interest in these trees, and that probably was the author's chief aim. For this reason it would be scarcely fair to grumble at its shortcomings from the scientific point of view. At times Mr. Coltman-Rogers is apt to be discursive, not to say garrulous, but, on the whole, his gossip is pleasant and humorous, and his book will find many readers who would be repelled by a more technical work. It certainly contains much solid information, and the careful reader will find many curious and interesting peculiarities of the species pointed out which, unaided, he might very easily overlook. No detailed descriptions are given, but the last forty pages are devoted to a series of tables which contain a great deal of accurate information in condensed form; these will be a useful help in identifying species, and especially in differentiating those which are closely allied.

The book suffers from careless proof-reading, and the reader is apt to be irritated by the number of errors, trifling though they may be. On p. 97, for instance, the Douglas fir is said to have been discovered by Menzies in 1792 and introduced in 1828; and then overleaf the respective dates are given as 1791 and 1827. It was not necessary to repeat the information, but at least the two accounts should tally. Kaempferi is spelt "Kaemferi," which jars one with whom the golden larch is a favourite tree. The invariable use of capitals as the initial letter for specific names is contrary to accepted practice, but perhaps the author has his private reasons for this.

On the whole, the book is pleasant and instructive, admirably printed, and light to handle, and may be recommended to those who contemplate the planting or study of one of the noblest and most interesting groups of the world's trees.

Physiology for Students and Practitioners.

A Text-book of Physiology: For Students and Practitioners of Medicine. By Prof. Russell Burton-Opitz. Pp. 1185. (Philadelphia and London: W. B. Saunders Co., 1920.) Price 32*s.* 6*d.* net.

TO add to the already numerous text-books on physiology is presumably to have the conviction that one is supplying what is lacking in those already in existence. The striking thing about Prof. Burton-Opitz's "Physiology" is that its author makes no such claim. In the first edition of a new book a claim for being really up-to-date would perhaps have been its best for recognition at a time when even some of the better-known books are somewhat delinquent in this respect.

If the author aspires to anything, it is to brevity, although his book has some 1140 pages of text. His object has apparently been to collect all the classic facts and theories and put them into new words. In this he has succeeded admirably, and his book, on the whole, compares well with its rivals. On controversial subjects he states fairly the different aspects of the case, and no pains have been spared in collecting facts and ideas for which free acknowledgment is made of the obvious debt to other text-books. The book reviews the whole subject in the most comprehensive manner. The greatest zeal for the explanation of phenomena is shown; indeed, to the physiologist there is just a suspicion of unnecessary explanation; but, on the other hand, the giving of elementary facts renders the book all the more readable by students commencing the study of the subject or by practitioners who have forgotten such matters. Students, however, using the book in preparation for examination should be warned that principles are more important than data. The giving of references at

the bottom of each page is excellent, but, although it is realised that a full bibliography is impossible, fuller references to the more recent work, especially in regard to the nervous system, would have been a distinct advantage.

The logical way in which the facts are put forward, the short allusions to the history of the subject and to comparative physiology, together with a freedom from any attempt to compile a book for examination purposes, will recommend it to the purely scientific worker.

Generally, the book is well written and produced, but the language, which contains many Americanisms, leaves no doubt as to its nationality, and does not enhance its literary value. The author does not acknowledge any help in the preparation of the volume, which must have entailed an enormous amount of work. We congratulate Prof. Burton-Opitz on its completion, and wish his excellent and ambitious text-book every success.

Our Bookshelf.

The Planting, Cultivation, and Expression of Coconuts, Kernels, Cacao, and Edible Vegetable Oils and Seeds of Commerce. A Practical Handbook for Planters, Financiers, Scientists, and Others. By H. Osman Newland. (Griffin's Technological Handbooks.) Pp. vi+111+xi plates. (London: Charles Griffin and Co., Ltd., 1919.) Price 6*s.* net.

MR. NEWLAND scarcely gave himself a fair chance when, to quote his introduction, he was "prevailed upon to issue as a separate book the chapters on 'Ground Nuts,' 'Palm Oil and Kernels,' 'Cacao,' and 'Shea Nuts,' which originally formed part of a volume on *West Africa*." In doing this he has added chapters on coconuts and other edible oil-nuts found throughout the Empire, and has adopted for the whole a comprehensive title, the promise of which it would require unusual skill in compression to fulfil in a book of 111 not very closely printed pages. Moreover, the space at the author's disposal is not well distributed; thus the important oil-seeds soya bean, cotton-seed, and sesame are disposed of in one chapter of seven pages, whilst an equal number of pages are given to reprinting Imperial Institute reports on strephonema, n'gore, n'kamba, n'kula, kamoot, and dika nuts. Interesting though these products may be, they are not of commercial importance at present, and reference to them is out of place in a book of this description. The illustrations are the best feature of the volume. T. A. H.

The Flora of Chepstow. By W. A. Shoolbred. Pp. x+140. (London: Taylor and Francis, 1920.) Price 10*s.* 6*d.* net.

IN number and quality the local Floras of this country probably excel those of any other, and afford a satisfactory measure of the enthusiasm with which systematic botany is pursued by British naturalists, including a large number of amateurs who are wholly free from any stigma of superficiality.

Indeed, the greatest authorities on the species of the British flora are nearly all amateurs, very few professional botanists, outside the great museums, having either the time or the inclination to devote themselves to this specialist study.

Among these authorities Dr. Shoolbred holds a place, and his "Flora of Chepstow" is a praiseworthy addition to floristic literature. The area of the lower Wye has long been a favourite hunting-ground among botanists, for its position and topography give it an uncommon richness.

While the author takes a thoroughly exclusive view of the size of species, still, a list of 974 Angiosperms alone is pretty good for an area of, roughly, 65 square miles, now seriously threatened by industrialism.

The critical genera are fully treated, and Dr. Shoolbred has had the advantage of assistance from such men as Marshall and Ley in dealing with their many difficulties. Mosses are also included, a feature worthy of further resuscitation.

Electricity and Magnetism: Theoretical and Practical. By Dr. C. E. Ashford. Third edition. Pp. xii+303. (London: Edward Arnold, 1920.) Price 4*s.* 6*d.*

THE chapter on Röntgen rays which has formed a part of previous editions of this school text-book has been replaced in the present edition by one on the passage of electricity through gases. In this some account is given of the broad generalisations which have followed from the work of Sir J. J. Thomson and his school, and the application of these theories in the thermionic valve. A few articles have been rewritten, and an appendix on Ohm's law has been substituted for the original description of apparatus. The popularity and worth of this book are reflected in the fact that it has been through the printers' hands no fewer than thirteen times since the first edition was published in 1903, and during that period has been twice revised to meet new requirements of theory and practice.

A Text-book of Geology. By Philip Lake and R. H. Rastall. Third edition. Pp. xiv+508+xxxiii plates. (London: Edward Arnold, 1920.) Price 21*s.* net.

A COMPLETE revision of this standard work has been carried out since the first edition was reviewed in NATURE for June 22, 1911. The account of coral reefs has been modified in accordance with modern theories, the chapter on ore-deposits has been rewritten, and sections on concretions, petroleum, and natural gas have been added to that on sedimentary rocks. In the stratigraphical section of the book the account of the Carboniferous system has been largely rewritten, and Mr. Rastall has contributed a new chapter on the history of igneous activity in the British Isles. Numerous other minor alterations have also been made.

Recent Advances in Organic Chemistry. By Prof. A. W. Stewart. With an introduction by Prof. J. N. Collie. Fourth edition. Pp. xvi+359. (London: Longmans, Green, and Co., 1920.) Price 21*s.* net.

ALTHOUGH the previous edition of this book was reviewed in NATURE so recently as in the issue for February 20, 1919, Prof. Stewart has written one new chapter, and made several additions to those already existing. The former directs attention to some of the problems which are still open to solution, such as the reason why carbon among all the elements is pre-eminent in its capacity for forming long atomic chains; the addition reactions of the aldehydes; molecular stability, etc. The chapter on polypeptides has received the addition of a section which attempts to trace in outline the connection between the synthetic materials and the naturally occurring proteins and their derivatives. A number of sections have also been added to various chapters with the object of bringing the book up to date.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The British Association.

LIKE Prof. Armstrong, I have followed with much interest the discussion about the British Association. I have had a long and intimate acquaintance with it, and have a strong affection for it. For one thing, it is so truly British—so far from perfect, yet so adaptable. I am not sure that my most earnest prayer for it is not that it may be saved from the reformer, especially the type of post-war reformer who threatens to organise, systematise, advertise, and Teutonise every British institution on which he can lay hands. It is surprising that no one has suggested the Association should be put under the Department of Scientific and Industrial Research.

I have heard the British Association abused all my life; my own Section has always been the worst that ever was and hopelessly mismanaged, except in the year when I was its president—at least, so I have always been assured. But all the time the British Association has been bringing me—a rustic—into the possession of troops of friends in all quarters of this country and of foreign lands. I have gained more scientific help from it than I can well acknowledge, and I am sure a vast number of my contemporaries will say the same.

As to the intelligent public, I doubt whether the Association ever did so much as some people affirm. It does a little, if only in letting a hospitable *bourgeoisie* see that men of science are well-meaning human beings, more like themselves than you would have supposed. At one period the Association fluttered the theological dovecotes and gave excellent copy for the Press. There has scarcely been a year in my time when the newspapers have not remarked ruefully that the president's address lacked the interest of Tyndall's at Belfast. It is not easy to see how the Association can give scientific enlightenment to those who have not even the elements of scientific knowledge. In these days it can scarcely hope to appeal to the Press except by its indiscretions.

I should be sorry to be open to any just taunt of unprogressiveness, and, indeed, I have read carefully and reflected upon all that has been said by your correspondents. But it is difficult to discern agreement on any clear and practicable plan of reform. The British Association is an organism, not a machine. It seems to me to have grown, and grown well—not overgrown. I would say: "Let it grow, my friends; most of you have had fair fruit from it. Let us be chary of root-and-branch reform." The Association is very flexible; a great deal must depend on the personalities of the men in charge. To be a local secretary at the elbow of the late Mr. George Griffith when he was arranging a meeting and managing his superior officers was a memorable and impressive experience. Everyone will be able to recall a run of success in a Section when an exceptional man had a spell of office as recorder. I am sanguine enough to believe that exceptional men, capable and disinterested, will still be found; and that if, as I am not prepared to admit, we are unfortunate at present, we may safely count on recovery.

Lastly, as to the masses, it should be remembered that science is not the novelty it was. It is astonishing how many of them have seen phosphorus burn in oxygen. Anyone who has been in the trade knows that the old type of science lecture for the people, when a serious effort was made to illustrate the methods and topics of science, is a drug on the market. You find yourself as powder among the jam of overt or covert entertainers. In this direction let us hope the Workers' Educational Association may bring about results that can never be attained by isolated popular lectures during a British Association week.

I trust that nothing in the foregoing may appear disrespectful to those who have expressed opinions on the same subject. It is, no doubt, of great value to have comments and suggestions from such competent observers. I have only intervened because it seemed to me that bare justice has scarcely been done to what is undoubtedly good and great in the Association as it stands, and to the ruling powers who have an exceedingly difficult task to perform.

ARTHUR SMITHELLS.

December 19.

Science and Fisheries.

No one will gainsay Mr. H. G. Maurice's fundamental premise (NATURE, November 25, p. 419) that scientific fisheries investigation is primarily a matter for the State—if the authorities have a due sense of their responsibility in selecting for the task scientific men whose training and ability specially fit them for the complex work. It has long been advised that the three centres of the kingdom should have an adequate scientific fisheries staff, at the head of which a trained scientific expert of wide views should be placed.

Under Mr. Maurice's second head it is asserted that statistics could not be secured, say by the Marine Biological Association at Grimsby or at any other port; but whilst there is no doubt that the best channel for these, as in the case of the Fishery Board for Scotland, is the fishery officers of the Government, Mr. Holt's work alone at Grimsby shows that the statement needs qualification. The excellent method of the Scottish Board, which was in 1884 inaugurated by Lord Dalhousie, should be followed. It would also be well that returns by all fishing crews should be sent to

the central office through the same agents, as was recommended in the scientific Report on Trawling in 1884. Mere enumeration of the sizes of fishes on board the ships, however, is insufficient. The observers should take in the whole surroundings of the products of the areas so as to be able to contrast them with others. It is also uncertain if the proposed comparison of the yield of the North Sea with pre-war days will result in any trustworthy information. Nature is superior to any influences on that head, Dutch statements notwithstanding. Again, the fact that much of the supply of fish-food for the public of this country comes from extra-territorial waters should not be held as a reason for international co-operation in fishery researches. Friendly co-operation between Governments is right, but it does not seem to be necessary in scientific fisheries researches. Britain did not attain her pre-eminence in the sea-fisheries by international aid, nor will international co-operation help her to maintain that position. The work of the Dutch alone is a sufficient criticism on the supposed necessity for international co-operation.

Mr. Maurice thinks that science has not yet proved the ineffectual and unnecessary nature of the closure of areas of the open seaboard, such as the Moray Firth. He has still to study the work of the *Garland* and other ships, as well as various experiences since Lord Dalhousie's Commission. Instead of the view of the futility of one nation working alone at scientific fisheries work, it may be that this is just where progress can best be made; and, besides, fisheries publications rapidly spread information over the world. Moreover, fisheries investigations are best carried out at marine laboratories in the midst of fishing-boats and in touch with the sea. That Great Britain continued to subsidise the international scheme during the war is, perhaps, of less moment than it appears when the results (chiefly statistics of fishes collected at ports, compiled by subordinates, and treated by the chiefs on land) are duly weighed.

There is little fear of the serious depletion of the stock of fishes in the ocean, and less of man successfully adding to it. Again, little is to be gained by a fortuitous prophecy as to good or bad seasons. The fishes are there to be captured in their seasons, though there is still much to be learned about them in marine laboratories and on board fishing vessels. There are not a few points for investigation, for instance, to be found in criticisms of the International Council at its inception (1902–3). A perusal of the British fisheries from early times may also be suggestive.

Mr. Maurice is to be commended for his friendly view of independent fisheries research and of giving a wide margin to Departmental work. If the Secretary for Scotland in 1896 had embraced similar broad views, one laboratory at least where the pioneer scientific fisheries researches of this country were done would not have been closed to-day and the supply of trained young men for the Department cut off. Mr. Maurice's closing words are excellent, only a Council for the National Exploration of the Sea should be substituted for the International Council.

W. C. McINTOSH.

I THANK you for the opportunity afforded me of commenting on Prof. McIntosh's letter, and him for his friendly criticism. I may, perhaps, be permitted, without discussing all his points in detail, to develop somewhat my views regarding international co-operation in scientific research, which Prof. McIntosh has not, I think, quite understood.

I cordially endorse the statement that "Britain did not attain her pre-eminence in the sea-fisheries by international aid, nor will international co-operation help her to maintain that position." Britain will maintain her pre-eminence, I think, in the future, as in the past, by the enterprise of her fishermen and fishing-vessel owners. But their enterprise is directed solely to the catching and marketing of fish. The practical object of research, as I conceive it, is mainly conservation and development. I think we must admit that, under existing conditions, there is a real danger of the depletion of the fishing-grounds up to the point at which fishing will be unremunerative, with all the undesirable results which must follow from that state of things. Whether we seek to forestall the danger by mere restriction of fishing operations, or by measures of development, or by a combination of the two, what we shall in fact be aiming at is the practical application of the results of scientific work on fishing-grounds which are open to all nations. No such measures as are here suggested can be effective unless they have the support of all the nations which have access to fishing-grounds. Such support is most likely to be accorded as a result of partnership in investigations and of agreement as to the conclusions to be drawn from them. The International Council does not claim to be above criticism, but if the necessity for international co-operation be admitted, it is entitled to support until a more effective organisation for combined research can be substituted for it.

That is one aspect of the matter, but there is another. As a layman I am greatly impressed with the vastness and the complexity of the problems of the sea. In order to solve them it does not seem to me to be sufficient that the different nations should be working independently at scientific fisheries work. Where so wide a field is to be covered, co-ordinated effort in a concerted programme must surely be of unusual value; in some inquiries simultaneity of observations is, I understand, of great importance. "The view of the futility of one nation working alone at scientific fisheries work" is not one that I have expressed; and if I believed that there was a serious risk of national work being subordinated to the requirements of international agreement, I would not urge international co-operation. I do, however, hold strongly that the value of much of the work of each nation depends upon its co-ordination with the work of others and upon the fact that it is part of an intelligently concerted programme of joint investigations. Whether as an outcome of our investigations we shall eventually be able, not merely to conserve fisheries, but even to develop them, remains to be proved. I will not embark upon prophecy, but I know that some of my scientific friends believe that this end will eventually be reached.

In his opening paragraph Prof. McIntosh refers to the proposal to form a central scientific fisheries staff for the United Kingdom. He will be interested to learn that an arrangement has now for some time been in operation under which the staffs of the Scottish Fishery Board, the Irish Department, and the Fisheries Department of the Ministry of Agriculture and Fisheries meet at regular intervals to frame their scientific programmes and to report progress, and that these meetings are generally attended, to the great advantage of the work, by a certain number of the distinguished men of science attached to our chief marine biological stations.

I am not sure whether I am to understand that Prof. McIntosh holds that science has proved closure of areas of the open seaboard to be ineffectual and unnecessary. I have not consciously expressed an opinion upon this subject, because, as a layman, I am unwilling to rush in where even a scientific angel may be disposed to tread delicately. As a Govern-

ment official I am discreet enough not to venture on a public discussion of the merits of so controversial a topic as the closure of the Moray Firth.

December 21. HENRY G. MAURICE.

Propagation of a Finite Number of Waves.

IT has been stated as a general proposition by physicists that it is impossible to propagate a finite number of simple harmonic waves without change of type, the reason being that the discontinuity of motion at the beginning and end of the train of waves cannot be represented by a simple sine or cosine function.

The proposition as stated is too general, and should be qualified. It would be true, however, to say that a finite number of simple harmonic waves cannot be propagated without change of type if the mean pressures in the wave-train and in the undisturbed medium are the same.

That a finite train of waves of unchanging type can actually be propagated in a medium in which the wave-velocity and group-velocity are the same may be seen from the following illustration:

Let the medium be enclosed in an indefinitely long pipe containing a piston on which a simple harmonic motion of amplitude a may be imposed. Let the medium and piston be at rest when the latter is in one of the *extreme positions*. If the motion is then started there is no discontinuity either in the velocity or in the acceleration. So long as the motion of the piston is maintained, simple harmonic waves are propagated through the tube in both directions, the mean pressure in one set being $p_0(1+a/\lambda)$ and in the other $p_0(1-a/\lambda)$, where p_0 is the undisturbed pressure.

At the moment when the motion is started the pressure on both sides of the piston is p_0, and this is the maximum or minimum pressure in each wave series, according as the direction of motion of the piston tends to dilate the medium or to compress it. The necessary increase and decrease of mean pressure in the two wave series are automatically supplied by the work done by the exterior force which must be applied to the piston to generate the successive waves. If the motion is stopped where the piston is in the same extreme position in which it was started, a finite number of simple harmonic waves are left travelling along the tube in opposite directions.

A. MALLOCK.

Solar Variation and the Weather.

MR. CLAYTON'S representation in NATURE of December 9 that, apart from seasonal and diurnal changes, the "chief, if not the only," cause of weather change lies in solar variations overlooks an important source of variation in the atmosphere which could not be allowed for on the lines of his investigation. No one will dispute that if Mr. Clayton finally substantiates his correlation results, which have been severely criticised in America by Dr. C. F. Marvin (*Monthly Weather Review*, March, 1920) they will be of great value in forecasting deviations from the normal of particular elements, such as temperature and rainfall, in coming seasons. But they will not help us to foresee the actual *sequence* of atmospheric phases embodying the combination of all elements which we call weather; and it is the precise sequence of changes, not the departure of one or more elements from normal during a given period, which, after all, is the primary aim in weather forecasting.

It seems almost certain that however closely types may recur, the atmosphere is never twice in the same condition, and this, I believe, is a prominent conviction in the minds of those meteorologists with a lengthy experience of daily weather maps. If a series of phases in the circulation of the atmosphere be represented by $A_1 B_1 C_1 D_1 \ldots$, it is conceivable that by an odd chance there might be a recurrence some time later of the particular phase A_2; but unless, which seems almost infinitely improbable, all the external forces acting upon the atmosphere at the moment A_2 are identical with those which were in operation at the moment A_1, there will be no cyclic repetition $A_2 B_2 C_2 D_2 \ldots$ to be maintained for a longer or shorter period. In place of the repeating cycle a very different series of phases might emerge; and it is on this principle that no two seasons are ever alike in the actual sequence of phases.

In other words, once set a fluid system like the earth's atmosphere in motion and change, it will possess an internal source of variability because identical dispositions of external forces never act upon identical phases. No doubt, with a sufficient number and quality of simultaneous observations, meteorologists could so diagnose the condition of the atmosphere as to be able to calculate what phase would grow out of a present phase a few hours later; but the prevision of distant phases, which is really at the root of the weather problem, seems at present quite impossible. L. C. W. BONACINA.

27 Tanza Road, Hampstead, N.W.3,
December 19.

Name for the Positive Nucleus.

WHILE the word "hydrion" does strictly express the meaning conveyed by the symbol H+, yet in the minds of chemists it connotes all those properties associated with its hampered state in solutions, especially aqueous solutions. Even if hydrion is not hydrated like other ions, yet there is probably some sort of electrical double layer which modifies its properties. The "wet" physical chemist might abandon his term "hydrion" and the symbol, recognising that the real hydrion (H+) will have entirely different properties if ever these are known. He is in possession, however, and is not likely to do this unless, perhaps, some variant term, such as "hydro-ion," might be found acceptable. The alternative symbol H is, of course, already to hand, and, indeed, more widely used than H+, which could be left to the physicists.

In spite of these minor difficulties, it appears to me that Prof. Soddy's suggestion (NATURE, December 16, p. 502) should be acceptable to chemists, largely because it is provisional in character and avoids the multiplication of words and symbols. Although it expresses a view as to the ultimate constitution of matter which may not prove correct, yet it is only the existence of such a view which necessitates a word and a symbol. If the other words suggested are to be taken as entirely non-committal, then the choice of one is less important at present, and, if effected, the word will probably soon acquire different meanings when used by different schools of thought.

E. B. R. PRIDEAUX.

University College, Nottingham, December 18.

The Physical Meaning of Spherical Aberration.

MAY I correct an obvious mistake of mine which I notice in my letter on spherical aberration appearing in NATURE of December 9? The second expression for intensity should read:

$$I = \text{const} \times \left[\left\{ \int_{a=0}^{a=a_1} J_0(aa) \cos \eta_a a^2 (a^2) \right\}^2 + \left\{ \int_{a=0}^{a=a_1} J_0(aa) \sin \eta_a a^2 (a^2) \right\}^2 \right].$$

L. C. MARTIN.

Imperial College, S.W.7, December 17.

Man and the Scottish Fauna.[1]

IN undertaking an estimate of the manner and degree in which the fauna of Scotland has been affected and modified in consequence of human occupation, Dr. Ritchie has brought together a very large array of facts, and, on the whole, he is laudably cautious in deduction therefrom. He begins by an attempt to visualise what is now Scotland as it was when man first settled there. Here is plenty of room for speculation, and we cannot but think that some lines in the sketch are drawn more firmly than is warranted by the evidence.

The earliest traces of the primitive peoples in Scotland are associated with the so-called fifty-foot beach. Their canoes, simple dug-outs of pine, have been found at Perth in the Carse clays of this period, and frequently in similar deposits in the Forth and Clyde valleys (p. 9).

Among the very numerous canoes exhumed in Scotland during the nineteenth century (seventeen dug-outs have been recorded from the Clyde valley alone), not one has consisted of any material but oak, the only native timber that remains sound for an indefinite period; but, accepting "pine" as *lapsus calami* for "oak," is Dr. Ritchie justified in assuming such a high antiquity for these canoes? Passing on to p. 20, we get a glimpse of a landscape scarcely likely to produce either oak or pine big enough for a dug-out.

Partial and incomplete as our survey of early Scotland must be, it yet affords a reasonably accurate picture of the country when Neolithic man . . . founded his most northern settlements in the British Isles 9000 or more years ago. It was a country of swamps, low forests of birch, alder and willow, fertile meadows and snow-capped mountains.

A difficulty arises in the stress laid by the author on the 50-ft. beach as the cradle of the human race in Scotland. He never mentions the 25-ft. beach which, being thousands of years younger than the other, is far better defined and more extensively preserved, especially on the west coast. Take, for example, the shores of the Bay of Luce; while the 50-ft. beach can only be traced here and there in fragments, the 25-ft. beach runs unbroken for miles, forming the terminal moraine of the land ice, without any margin between its ancient high-water mark and the base of the ground moraine—a mantle of boulder clay in places 100 ft. thick. The difficulty consists in accounting for the existence of men, or at least for the preservation of their traces, in the older 50-ft. beach; whereas it is clear that the land ice was grinding over all after the elevation which formed the younger 25-ft. beach.

Passing to later times, Dr. Ritchie takes us on firmer ground, and will meet with no dissent from his proposition that the main factor in the extinction of some indigenous mammals and birds was the destruction of the primeval forest, the woodland which survived longest being consumed as fuel for iron-smelting in the eighteenth century. The squirrel has found its way back as plantations increased; so have the great spotted woodpecker and the jay; while the capercailzie, which became extinct towards the close of the eighteenth century, was successfully re-established at Taymouth in 1837–38, and now abounds in several counties. We still await the return of the beautiful green woodpecker (not mentioned by Dr. Ritchie), which Thomas the Rhymer listened to long ago on Tweedside.

FIG. 1.—Soay sheep—a primitive domesticated breed preserved only in Scotland. From "The influence of Man on Animal Life in Scotland."

> In a mery mornynge of Maye,
> By Huntle bankkes myself allone,
> I herde the jay and the throstle cokke,
> The mawys menyde hir of hir song,
> The *wodewale* beryde as a belle,
> That all the wode abowte me ronge.

While game-preserving is responsible for the disappearance of the polecat and the goshawk, our loss of the osprey and the erne must be laid to the account of egg-collectors. On the other hand, Dr. Ritchie enumerates many species of beast and bird that have increased with the ad-

[1] "The Influence of Man on Animal Life in Scotland: A Study in Faunal Evolution." By Dr. James Ritchie. Pp. xvi+550. (Cambridge: At the University Press, 1920.) Price 28s. net.

vance of agriculture—moles, for instance, and field voles, besides both insectivorous and grain-eating birds.

The author follows the late Dr. Günther in giving specific rank to what are now recognised as no more than local varieties of the brown trout

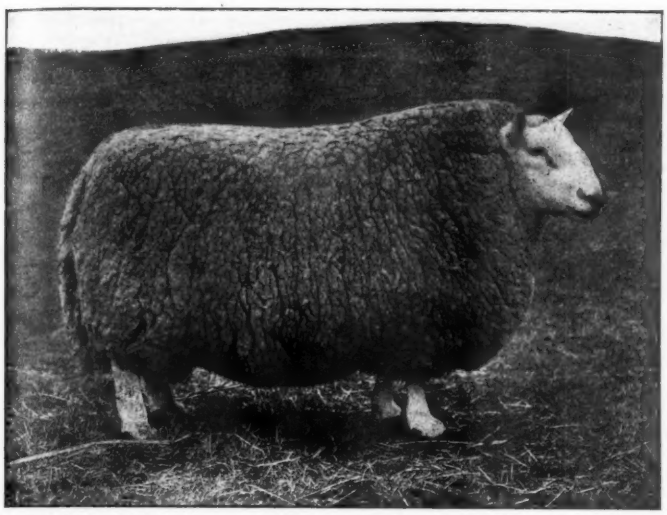

FIG. 2.—Cheviot sheep—a modern result of selective breeding (champion, Highland Show, 1914.) From "The Influence of Man on Animal Life in Scotland."

—*Salmo fario* (misnamed *S. trutta* on p. 278). The signal success which rewarded the acclimatisation of this fish in New Zealand was first achieved with trout, not from Lochleven, but from the Wooburn at High Wycombe. A few slips and misprints await correction in a future edition. Loch Askaig (p. 134) should be Loch Arkaig; Loch-an-Eilein on the same page appears as Loch-an-Eilan on p. 192, the correct Gaelic being Loch-an-eilain. Dr. Ritchie would probably wince if we were to write about "Northumberlandshire," just as we did when we read "Sutherlandshire" on p. 126.

Few of the numerous illustrations are worthy of Dr. Ritchie's interesting treatise. The beaver (Fig. 37) and the bittern (Fig. 64) are mere caricatures, and poor at that. Some of the figures, however, serve well to illustrate the influence of domestication and selective breeding upon primitive types of mammal, as in the case of the sheep. Although it may not be possible to define with precision the various species which have contributed to produce the modern breeds, sheep, though a race almost exclusively Palæarctic and Nearctic, are peculiarly liable to modification by food and environment, and are more plastic in that respect than cattle, horses, or swine.

While indicating some hesitation in accepting all Dr. Ritchie's conclusions, we congratulate him on his useful contribution to zoological literature, and we are grateful for the excellent index to the book.

Some Problems of Lubrication.[1]

By W. B. HARDY, F.R.S.

IN lubrication, a fluid or other body is used to decrease the friction between opposed solid faces. The lubricant may act in one of two ways. It may separate the faces by a layer thick enough to substitute its own internal friction, modified by the mechanical conditions in which it finds itself, for that of the solid faces; or it may be present as a film, too thin to develop its properties when in mass, which reacts with the substance of the solid faces to confer upon them new physical properties. In the latter case the solid faces continue to influence each other, not directly, but through the intermediation of the film of lubricant. There are indications that these two types of lubrication—one in which the solid faces intervene only owing to their form, rate of movement, etc., and not by their chemical constitution; the other in which the chemical constitution is directly involved—are discontinuous states in that one cannot be changed gradually into the other by simply thinning the layer of lubricant. The change from the one to the other is probably abrupt.

It may by no means be asserted that resistance to relative motion is always least when the solid faces are floated completely apart; it would, indeed, probably be truer to say of the best lubricants that friction is least when the "boundary conditions," to use Osborne Reynolds's phrase, are fully operative.

This address is concerned wholly with "boundary conditions," and we get directly to the heart of the problem by certain simple experiments. If a glass vessel, such as a bottle, is placed upon an inclined pane of glass at a certain angle it slips smoothly down. The glass plate is an ordinary plate cleaned with a cloth. In the usual sense of the word, the plate is not lubricated; the surface is "dry." The lower half of the plate is then wetted with water, and the bottle is now found to slip on the unwetted part, and to be pulled up sharply by friction when

[1] A Friday evening discourse delivered at the Royal Institution on February 27, 1920.

it reaches the wetted part. It is not sufficient, therefore, to interpose a liquid film between solid faces to get lubrication; indeed, as the experiment proves, water increases the friction; it is an anti-lubricant for ordinary faces of glass.

Is, then, the quality of lubricant a property of a fluid? Does water fail to act merely because it does not possess that property to which the name "oiliness" is sometimes given? Another simple experiment supplies the answer. Instead of a glass plate, let us use a plate of ebonite. The glass plate does not readily slip on this. The angle at which slipping occurs is steeper than when a glass plate is used. Now, when the lower half of the ebonite plate is wetted, it is found that a glass bottle encounters relatively high friction on the unwetted part, but slips quite freely on the wetted part. Water, in short, is an admirable lubricant for glass on ebonite. Here is another plate, picked up at random in the laboratory of the Royal Institution. Its composition is unknown. Tested in the same way, water has no detectable influence on the friction between glass and the surface of this plate.

It will be well to confess at once that these simple experiments raise questions which are as yet without an answer, and that much of what follows concerning them is merely tentative. They seem to establish two things, the first being the curious paradox that a film of fluid introduced between two surfaces does not always decrease friction—it may, indeed, very much increase it. The second is that the quality of "oiliness"—the quality, that is, which enables a substance to act as a lubricant—seems to be not the property of a given fluid, but only of that fluid considered in reference to a particular surface.

It is necessary at this stage to clear away a possible explanation of the paradox. When two solid faces are separated by a thin film of fluid, capillary forces operate, and, in certain cases at any rate, these forces act so as to resist slipping. They will so act, for instance, when the movement of one face past the other increases the area of the free surface of the film. Water has a high surface-tension; the capillary forces to which it gives rise are usually large; therefore it is pertinent to ask whether, when a layer of water diminishes the facility for the slipping of glass on glass, it is owing to capillary action. A qualitative answer is to be found in the fact that water does in some cases, as when glass is applied to ebonite, increase the facility for slipping; and the late Lord Rayleigh furnished the quantitative answer. He calculated the magnitude of the capillary effect and found it negligible compared with the actual friction of glass on glass wetted with water. An appeal to capillary forces of this type will not solve the paradox.

Some light is thrown upon it when we inquire into the state of the surface of glass that has its friction increased by water. Surfaces of glass "cleaned" in the ordinary way by rubbing with a glass cloth, or glass faces which have been simply exposed to the air, are in point of fact not clean, but highly lubricated with a film of matter derived from the cloth or condensed from the atmosphere. This "grease" film is of invisible thinness. It is probably of the order of 1 $\mu\mu$ in thickness—that is to say, one-millionth of a millimetre. It can be removed by soap and water, which in turn must be removed by a stream of water, and the plates dried in clean air out of contact with solids. The film reforms quickly—very quickly in London air, and less quickly in the country. A "grease" film also creeps over a cleaned glass face from ordinary solids with which it may be in contact. Still, when due precautions are taken—and they are many—it is possible to get a glass face which seems to be really clean.

The first property of clean faces is that their friction, one for the other, is very high; indeed, it is impossible to make them slip past one another. One glass plate may be forced past another, but true slipping does not take place; they tear at the point or points of contact. It is easier, in short, to disrupt the actual substance of the glass itself than to get the surfaces to slip over one another. Clean glass faces "seize" when they touch.

When chemical substances are tested as lubricants on clean glass faces, a remarkable fact emerges—namely, that some are quite neutral in that they do not alter the resistance to slip in the least; such are water, alcohol, benzene, and strong ammonia. Other substances have some lubricating action, great or small—that is to say, they decrease the force needed to produce slipping; such are the alkalis, trimethylamine and tripropylamine, the fatty acids—*e.g.* acetic acid—and the paraffins. Those fluids which act as lubricants are not necessarily fluids of any considerable viscosity; indeed, a high viscosity is compatible with the absence of any lubricating action other than flotation. Thus glycerine facilitates the slipping of clean glass on clean glass only when it is present in quantity sufficient to float the surfaces apart. On the other hand, acetic acid and tripropylamine—substances of low viscosity—are admirable lubricants of glass.

None of the fluids tested was found to raise the friction of clean glass faces. They were either neutral, or decreased friction to a greater or less extent. The power of increasing the friction of glass faces which neutral fluids, such as water, possess is due, not to their action on the glass itself, but to the fact that they interfere with the action of the invisible grease film. Water on an ordinary glass face acts as an anti-lubricant; on really clean glass it is "neutral."

All solid faces, however, do not distinguish chemical substances into those which are "neutral" and those which possess lubricating properties. Nearly one hundred substances have been tested on burnished faces of bismuth, and in every case some decrease of friction was observed.

A comparison of the lubricating action of simple chemical substances on clean faces of glass or of bismuth would seem to show that the quality

of oiliness is due to some reaction between the substance and the solid face. Much is still obscure, but certain facts seem to be capable of interpretation in no other way. Thus water and ethyl alcohol have no detectable lubricating action on clean glass, whilst both are moderate lubricants for clean bismuth.

The thickness of the layer needed to lubricate is astonishingly small. It is quite invisible, and probably only one or a very few molecules thick. To discuss this adequately would take too long, but the fact may be instanced by an experiment of great beauty. A tiny drop of, say, acetic acid or tripropylamine is placed near one corner of a plate of clean glass 6 cm. square; nothing detectable by the senses happens; the drop is there, and that seems to be all. But the whole surface of the plate has, in fact, been changed fundamentally. It is now fully lubricated by an invisible film which has spread rapidly over it from the drop. The presence of this film may be detected by measuring the friction or by following the migration of two drops of fluid over the face of the plate. It will be found that the drops attract one another under conditions which point to the cause being the contractility of the invisible film.

This brings me to the second part of my subject—namely, the relation of lubricating power to chemical constitution.

In particular experiments with bismuth, a slider having a curved surface was applied to a plain surface of metal, both surfaces being highly polished, and the force required to initiate movement was measured. This force measures what is usually called static friction as opposed to the kinetic friction when the surfaces are in relative motion. The static friction was found to be a function of the weight of the slider. Therefore, the ratio of the weight of the slider to the friction was used as a relative measure. The results appear in the following table:—

Static friction 0·5 when the faces were clean.

CHAIN COMPOUNDS.

Alcohols.

	Static Friction.		Static Friction.
Methyl	0.29	*iso*Propyl	0.32
Ethyl	0.32	*iso*Butyl	0.30
Propyl	0.34	Allyl	0.29
Butyl	0.30	Glycol	0.30
Amyl	0.27	Glycerol	0.22
Octyl	0.25	Penterythritol ...	0.40
Cetyl	0.17		

Acids.

	Static Friction.		Static Friction.
Formic	0.45	*n*-Octane	0.32
Acetic	0.40	Stearic	0.15
Propionic	0.31	Oleic	0.10
Valeric	0.28	Ricinolic	0.02
Caprylic, fluid ...	0.19	α-Lactic	0.20
Caprylic, frozen on plate	0.05	Glyceric	0.22

	Static Friction.		Static Friction.
Acetone	0.32	Ethyl ether ...	0.33
Methyl ethyl ketone	0.29	B.P. "Paraffin"	0.20
Ethyl acetate ...	0.36	Solid paraffin, m.p. 30·5°	0.09
Ethyl valerianate...	0.35	Solid paraffin, m.p. 46°	0.07
Tristearin	0.24	Carbon tetrachloride	0.43
Triolein	0.14	Chloroform ...	0.30
Acetone dicarboxylic diethyl ester ...	0.29	Amylene	0.26
n-Hexane	0.37	Octylene	0.28
n-Heptane	0.346	Butyl xylene ...	0.27

RING COMPOUNDS.

	Static Friction.		Static Friction.
Benzene	0.34	Ethyl cinnamate ...	0.32
Ethyl benzene ...	0.32	Thiophenol ...	0.22
Iodobenzene ...	0.30	Benzyl hydrosulphide	0.23
Toluene	0.28	Pyridine	0.33
Xylene	0.30	Piperidine	0.32
p-Cymene	0.31	Naphthalene ...	0.29
Phenol	0.25	Anthracene ...	0.26
Catechol	0.39	β-Naphthol ...	0.38
Quinol	0.40	Naphthoic acid ...	0.39
m-Cresol	0.26	Carvacrol	0.23
Benzyl alcohol ...	0.31	Thymol	0.24
Benzoic acid ...	0.38	Menthol	0.26
Phthalic acid ...	0.37	Dipentene	0.31
Cinnamic acid ...	0.27	Camphor	0.24
Benzilic acid ...	0.45	Active ethyl ester of camphor oxime	0.33
Salicylic acid ...	0.41	*iso*Cholesterol ...	0.27
Ethyl benzoate ...	0.33		
o-Phthalic ester ...	0.27		
Ethyl hydrocinnamate	0.28		

CYCLIC COMPOUNDS.

	Static Friction.		Static Friction.
*cyclo*Hexane ...	0.31	*cyclo*Hexanone ...	0.35
Methyl *cyclo*hexane	0.30	1 : 2-Methyl *cyclo*hexanone ...	0.32
1 : 3-Dimethyl *cyclo*hexane	0.29	1 : 3-Methyl *cyclo*hexanone ...	0.35
*cyclo*Hexanol ...	0.20	1 : 4-Methyl *cyclo*hexanone ...	0.33
1 : 2-Methyl *cyclo*hexanol	0.28		
1 : 3-Methyl *cyclo*hexanol	0.25		

Ammonia fortiss....	0.34	Castor oil	0.03
Triethylamine ...	0.30	Water	0.33
Tripropylamine ...	0.26		

It will be seen that static friction is a function of the molecular weight of the lubricant, and in a simple chemical series of chain compounds, such as fatty acids and alcohols or paraffins, a good lubricant will be found if one goes high enough in the series; but it is not a simple function. The friction, for instance, rises sharply in moving from $CHCl_3$ to CCl_4, and from phenol to catechol and quinol. The influence of molecular weight is overshadowed by the influence of chemical constitution.

In some simple chemical series the relation appears to be a linear one. Examples are paraffins

and the series benzene, naphthalene, anthracene.

The relation of lubricating qualities to viscosity broadly resembles that to molecular weight. In a simple chemical series lubrication and viscosity change in much the same way with molecular weight, but that there is no fundamental relation between viscosity and lubrication is shown by the following figures:—

	Viscosity at 25°.	Static Friction.
Carbon tetrachloride	0.0096	0.43
Chloroform	0.0056	0.30
Acetic acid	0.0122	0.40
Octylic acid	0.0575	0.19
Benzene	0.0065	0.39
Toluene	0.0058	0.28
Benzyl alcohol	0.0558	0.31

Fluidity of the lubricant has no constant significance. The curves for acids, alcohols, and paraffins show no break where, with increasing molecular weight, the lubricant becomes a solid at the temperature of observation. Compare also benzene, naphthalene, and anthracene, menthone and menthol, thymol and carvacrol.

Perhaps the most unexpected result is the distinction between ring and chain compounds. The simple ring compounds, benzene, naphthalene, and anthracene, show the linear relation to molecular weight, and values are much the same as those for paraffins of the same molecular weight. The similarities, however, end here, for any change in the molecular structure produces opposite effects according as it takes place in a chain or a ring. Thus a double bond decreases the lubricating action of a ring compound, but increases that of a chain compound. As examples, compare naphthoic acid with double-bonded oxygen, with naphthalene, menthone with menthol, *cyclo*hexanone with *cyclo*hexane, benzoic acid with benzene. As examples of double-bonded carbon, compare cinnamic ester with hydrocinnamic ester, dipentene, having two unsaturated carbon atoms, with menthol and *cyclo*hexane. Also the more saturated cyclic compounds are better lubricants than the less saturated ring compounds. When a ring and a chain are joined, as in butyl xylene, the result is a better lubricant than either.

The esters occupy a quite unexpected position. The simple aliphatic esters are worse lubricants than their related acids and alcohols. The ring esters, on the contrary, are better lubricants than are their related acids (*e.g.* ethyl benzoate and benzoic acid).

Perhaps the most interesting substances are the hydroxy-acids with CH and COOH groups. This conjunction produces a remarkable increase in the lubricating power of a chain compound (lactic acid and ricinolic acid), and almost destroys lubricating action in the case of the ring compounds (salicylic and benzylic acids).

In the ring compounds the replacement of hydrogen decreases lubricating power in the case of N, :O, or .COOH, and increases it in the case of other groups in the order $C_2H_5 < CH < OH$.

The effect of a second group of the same or of a different kind is to decrease the effect of the first. Compare, for instance, toluene with xylene; catechol, quinol, and cresol with phenol; and methyl *cyclo*hexanol with *cyclo*hexanol. The simpler the group, the more effective it is. Compare cymene with toluene or xylene, and benzyl alcohol with phenol.

When the atoms are disposed with complete symmetry about a carbon atom, the result is a very bad lubricant, as we see in carbon tetrachloride and the alcohol penterythritol

$$C(CH_2 \cdot OH)_4.$$

It will be noticed that no ring compound is a good lubricant. Even cholesterol with the molecular weight 366 is no exception.

The group SH acts much as the group OH, thiophenol, $C_6H_5 \cdot SH$, and benzyl hydrosulphide, $C_6H_5 \cdot CH_2 \cdot SH$, resembling phenol and benzyl alcohol respectively.

Concerning one matter—and that the most fundamental—some conclusion must be reached, even though it be upset later. What is friction due to? The "Encyclopædia Britannica" is in no doubt as to this. Friction, it says, is due to inequalities of the surface. This conclusion cannot, I think, be accepted. Why, if it be true, should clean burnished faces of glass or bismuth refuse to slide over one another? It does not even accord with such simple facts as we now know. For instance, the friction of an optical face of glass was found to be the same as that of ordinary plate glass within the limits of accuracy aimed at; and both the optical face and the ordinary plate were found to give higher values than ground glass.

The subject cannot be fully discussed here, but I think we may conclude with some confidence that the friction both of lubricated and of clean faces is due to true cohesion—to the force, that is, which binds together the molecules of a solid or of a fluid. If there were no seizing, there would be no friction. The function of the lubricant is to diminish the capacity for seizing by saturating more or less completely the surface forces of the solid. In some cases it seems to abolish it completely, so that static friction vanishes.

The subject of lubrication is of interest to the engineer, but it is perhaps of more interest to the physicist, for it offers a means of exploring the most difficult regions of the physics of boundary zones—namely, the surface energy of solids. It will, for instance, I believe, enable us to prove that the simplest chemical change at the surface of a metal takes place only when the surface energy is decreased thereby. The film of oxide of sulphide which forms on copper acts as a very effective lubricant, and it acts also like a grease film in preventing water from wetting the surface; and from both of these facts we may conclude that the presence of the film lowers the surface energy of the metal.

Obituary.

PROF. ITALO GIGLIOLI.

AMONG the famous band of workers who built up a scientific agriculture in the nineteenth century the name of Italo Giglioli will take a high place, not only for what he did himself, but also for what he inspired others to do. Both his father and his grandfather had become exiles from Italy in the turbulent days of the early revolutions; the father came to Edinburgh, took a medical degree, and then settled in London to practise. The revolution of 1848 attracted him back to Italy, where, in 1852, at Genoa, a son was born to him to whom the name Italo was given as the first to be born in the native land.

Italo Giglioli devoted himself to the teaching of scientific agriculture, which he believed to be his country's great need. He was elected professor at the age of twenty-four, and taught, first at Portici, and then at Pisa, where he stayed until his death, on October 1, at sixty-eight years of age, playing a great part in the development of these two schools to their present honourable position. For this work he was well fitted. He had an unusually good knowledge of English and of other languages besides his own, and was thoroughly familiar not only with the investigations of Lawes and Gilbert at Rothamsted and of other British agriculturists, but also with the French and German work. In 1888 he drew up a long report for the Italian Ministry of Agriculture on British agricultural education (*Annali di Agricoltura: Educazione Agraria Britannica*, Rome, 1888), written with full knowledge, and containing much information that the student could obtain elsewhere only with difficulty. He kept up his interest in English investigations throughout his working life, and was usually appealed to by English workers who desired information about Italian agriculture.

Giglioli's published work covers a wide range; on the physiological side it deals with the functions of essential oils in plants (*R. Accad. dei Lincei*, 1911, vol. xx.); the biological absorption of methane, in which he confirmed the conclusion of Söhngen and Kaserer that methane is oxidised by certain micro-organisms (*Studi e Richerche*, Pisa, fas. 22, 1909–14); and the resistance of seeds to chemical agents. It is not, however, as a worker on abstract laboratory problems that Giglioli will be remembered. His more important investigations were on the agricultural side. He carried out experiments at the Experimental Station at Suessola on the cultivation of wheat, summarised in "Il Frumento: sue varietà e concimi" (Portici, 1888), and in later reports. In these he dealt with varieties, manuring, and such special cultural treatments as the effect of electrification, of manganese, etc. He also dealt with the cultivation of the cork tree ("La cultura del Sughero," Portici, 1902); the effects of chemical manures in arid climates; phylloxera; and silage—all important subjects in Italian agriculture.

Giglioli's best work was probably as a teacher, and some of the tributes paid by his students are very touching. His book, "Chimica agraria campestre e silvana" (Naples, 1884 onwards to 1902), was much used in Italy. The more general agricultural questions are discussed in his well-known "Malessere agrario ed alimentare in Italia" (Portici, 1903). This contains probably the best available summary of Italian agricultural conditions in comparison with those of other countries, and also an examination of the causes and possible remedies for agricultural distress.

Giglioli's death severs a link between British and Italian agriculturists, and is equally regretted in both countries. It is the hope of all concerned that the close relationship for which he strove may be maintained and strengthened.

E. J. RUSSELL.

DR. C. A. SADLER.

DR. CHARLES A. SADLER was a student at Liverpool in the early days of the University there. After graduating with honours in physics (1905), he joined Prof. Barkla—then lecturer in the University—in his investigations of the secondary rays emitted by substances exposed to Röntgen radiation. Sadler's introduction to the work was made in a detailed investigation of the absorption of the characteristic X-radiations.

The results of these researches were published by Barkla and Sadler in a series of papers in the *Philosophical Magazine* dealing principally with the laws of X-ray absorption, the homogeneity of the characteristic radiations, and the relation between the characteristic radiations and the atomic weights of the chemical elements emitting them. Sadler afterwards (while holding the Oliver Lodge fellowship) continued the investigation of the energy of the characteristic radiations by an accurate and detailed examination of these radiations from several elements. He also applied Townsend's method to a study of the secondary corpuscular radiation, and found that a certain portion of this radiation was associated with the characteristic X-radiation.

In 1911 Sadler was appointed lecturer in physics at University College, Reading. There he became interested in mechanical work, and in 1915 he turned his skill to good account by organising most successfully a training centre for munition workers. Shortly before the armistice he left academic work to undertake research of a technical character with Messrs. Allen and Simmonds, of Reading. This work was, however, cut short by a breakdown in health, followed by his early death on December 5.

Sadler's interest and skill in mechanical methods were exceptional. He was an able experimenter, an accurate observer, an indefatigable worker. These gifts were very highly esteemed by those with whom he collaborated.

Notes.

THE Dyestuffs (Import Regulation) Bill was read for a third time in the House of Lords on December 23 and has been given Royal assent. The measure was referred to in the King's Speech at the close of the session as "the Act regulating the importation of dyestuffs, in order securely to establish the dyestuffs industry in this country."

WE begin this week the publication of a Calendar of Scientific Pioneers, which it is proposed to continue throughout the year. There is inspiration as well as interest in the lives and work of the great men of science thus recalled to memory, and many readers will, we believe, welcome this additional feature in the columns of NATURE. The Calendar has been prepared by Engr.-Comdr. Edgar C. Smith, H.M. Dockyard, Devonport, who has for many years been engaged in compiling biographies of all leading contributors to the advancement of natural knowledge.

A GREAT earthquake on December 16 is reported from the province of Kansu, on the Upper Hoang-Ho, in north-west China. The city of Ping-liang was much damaged, and 2000 persons are said to have perished. Prof. H. H. Turner and Mr. J. J. Shaw, in the *Times* of December 28, give reasons for believing that this earthquake was the origin of the great seismic disturbance registered on December 16. With regard to the suggestion of an Alaskan origin referred to last week (p. 542), it may be of interest to recall the last great earthquakes in that country. They occurred on September 3 and 10, 1899, the latter being the more violent. Though the seismographic evidence implied an origin in or near Alaska, no direct evidence reached this country until September 26, when the *Times* of that date published a short account of the violent earthquakes in Yakutat Bay. The magnitude of the disturbance was not, however, realised until 1905, when Messrs. Tarr and Martin showed, from the evidence of dead barnacles and mussels still adhering to the cliffs, that the uplift of the crust was in one place as much as 47 ft. 4 in.

THE third half-yearly report on the progress of civil aviation has just been issued as a White Paper (Cmd. 1073). It is an interesting document in view of the prevailing conditions in the industry, and holds out hope of a more prosperous future. It is pointed out that regular air services have now been established from London to Paris, Brussels, and Amsterdam, and that passenger, mail, and goods traffic is increasing. The total number of aeroplane miles flown in the half-year ending September 30, 1920, is nearly 700,000, whilst the aggregate since May, 1919, exceeds 1,000,000. The number of passengers by air exceeds 30,000, whilst the goods carried weigh little less than 90 tons. In value the imported goods exceed 500,000*l*., whilst the exports and re-exports are about half that amount. As part of the mail services, about 50,000 letters have passed each way between London-Paris, Brussels, and Amsterdam with a regularity which is notable. Of the three routes the best shows 94 per cent. of deliveries within three hours of schedule time, and the worst 76 per cent. As part of the organisation for further improving these records, it is stated that the wireless direction-finding apparatus installed at Croydon has proved its value, enabling aircraft to correct their course in thick weather. The equipment of aircraft with apparatus for wireless telephony is extending, as it is found to be of considerable assistance to navigation. The fatal accidents are given as in the ratio of 1 per 50,000 miles flown or per 5000 passengers carried. The international character of flying is prominently brought out in a concise statement of activities in other countries than Britain, and shows a breadth of interest which will stimulate efforts to overcome the present difficulties experienced by those engaged in civil aviation.

H.M. STATIONERY OFFICE has published an Interim Report on Glass Bottles and Jars and Scientific Glassware, prepared by a Sub-Committee appointed by the Standing Committee on Trusts and adopted by the Standing Committee (Cmd. 1066, price 2*d*.). The section on scientific glassware is of great interest and importance to all scientific users. After pointing out that prior to the war the whole of the scientific glassware used in this country was imported from enemy countries, principally Germany, the Committee describes the efforts made by certain manufacturers of glass bottles, under inducements by the Government, to develop the scientific glassware industry in Great Britain. The report points out that British manufacturers have to meet to-day foreign competition the nature of which may be gathered from the fact that, "favoured by 'exchange' rates and other conditions, goods of the kind now being made in this country are being supplied by Continental manufacturers at prices less than the actual cost of manufacture here, whereas for goods that are not yet being manufactured here prices are being charged by the Continental makers which mean to the consumer approximately five times the pre-war price of such goods." Finally, after declaring that it is outside its functions to report on the demand of the industry for a prohibition of imports of scientific glassware except under licence, the Committee says: "We cannot refrain from expressing the hope that his Majesty's Government will not find it impossible to implement the verbal assurances said to have been given to manufacturers; for it would appear to be only in that way that this country can be saved from returning to the pre-war position of dependence upon foreign countries for their supplies. We would add that, in our view, at the same time users of such glassware should also be safeguarded as to prices, and that the desired assistance should only be given for a limited period, with powers of withdrawal if it were found that manufacturers were in any way inclined to take advantage of the situation by unduly raising prices."

THE Annual Report of the Chief Medical Officer, 1919–20, Ministry of Health, has recently been issued, being the first annual medical report of the Ministry of Health. The greater part of the volume is occupied with a survey of the general health, of epidemiology and infectious diseases, and of the work of the sections into which the Medical Department of the Ministry of Health is now divided. In the appendix to the

volume Dr. Monckton Copeman discusses the relationship of smallpox and alastrim in connection with an outbreak of an anomalous varioloid disease in Norfolk. The disease was introduced from some locality in the Mediterranean area, and, although undoubtedly of the nature of smallpox, would seem more closely to resemble that variety which has been studied in Brazil known as "alastrim." Sir David Semple also gives a brief account of rabies and of the various systems of anti-rabic inoculation.

THE Research Defence Society has published an essay on "Vaccination" by Dr. Mary Scharlieb. A brief history of smallpox inoculation and of Jenner's work on the introduction of vaccination is given, followed by a short account of the symptoms of unmodified smallpox. The "Leicester experiment" is next described and discussed at some length. Finally, the outbreaks of smallpox at Dewsbury, Ravensthorpe, Gloucester, and Glasgow are referred to, and the influence of vaccination on the incidence and mortality of the disease is considered. The essay should be useful to those who desire to have evidence of the value of vaccination. The essay (together with others on the work of the Medical Research Committee, on the value of experiments on animals, and on the prevention of tetanus during the war, already noticed in these columns) may be obtained from the Secretary, 11 Chandos Street, W.1, price 2*s*. the set.

ANCIENT Oriental chemistry and its allied arts are discussed in the November issue of *Man* by Mr. Masumi Chikashige. The author begins with a review of ancient chemistry in Japan and China, consisting in the latter country of two parts: theories and gold-making, the latter having in its turn two aims, wealth and eternal life. He then passes on to the question of bronze in China and Japan, and supplies a series of analyses of its component elements. Finally, he describes the manner in which iron swords are forged. He concludes by saying: "We may recognise now some resemblance to damascened steel. If the Japanese learned this method of welding from the naturalised Chinese, where had the latter learnt their art? Whether it was their own, which made its way westward to Europe through India and eastward to Japan, or whether, on the contrary, they learned the art from India, is not now to be settled."

THE Asiatic Society of Bengal has published among its Memoirs (vol. vii., No. 3) an important paper by Mr. J. Hornell on "The Origins and Ethnological Significance of Indian Boat Designs." Surveying the shores of the Indian peninsula, Mr. Hornell describes, with good illustrations, the various types of boats now in use and many ceremonies in connection with their launching and employment, with a review of our knowledge of the ancient sea-trade with India. The most interesting part of the paper is an attempt to show how foreign influences have created or modified the types which exist at present. Thus he suggests that compound masts are essentially Mongoloid in origin, being seen to-day among Burmese, Indonesians, and the southern Chinese, and that on the west coast the use of the outrigger for coasting vessels was discarded at a comparatively early period under the influence of seamen from the Persian Gulf and the Red Sea. Also, since the single outrigger and balance-board designs are both Polynesian in affinity, their general diffusion on one or the other of our Indian coasts points to the conclusion either that some of the coast-folk of India are closely allied to the races of Oceania or that it is due to trade relations. Inland boat designs are on a very different footing, the first and larger group having distinctly Egyptian affinities, and the other equally well-marked Babylonian relationship.

THE second volume of the Proceedings of the Lahore Philosophical Society, which forms a record of the papers read before the society during the years 1916–20, has been received. The first volume contained papers read during 1914–16; we gather that lack of funds has prevented the issue of this second volume until the present time, and that publication has now been made possible by a grant of money from the Punjab University. The present volume, of eighty pages, contains records of thirty-two papers, of which eight are printed *in extenso* and the remainder in abstract. The papers are of two kinds: records of original work and summaries of recent researches; the mathematical, physical, and biological sciences are all represented. The membership roll is about fifty, and meetings are held every month during the academical session. A society such as this fulfils an important function in the intellectual life of a comparatively remote and isolated community. While authors of original researches will presumably publish them in other periodicals as well as in these pages, the present volume forms an interesting record of the activities of a society on the successful foundation and continued existence of which the members are to be congratulated.

WE have recently received a small booklet dealing with a proprietary fluid which has been placed on the market under the name of "Solomia." It is claimed to destroy any large insect pest—aphids, bugs, spiders, caterpillars, worms, etc. Further, it is stated to be non-injurious to crops, fruit, or grass, and its efficacy to be unaffected by weather conditions. If "Solomia" can effectively carry out all that its promoters claim for it, there is no doubt that it is a very remarkable mixture.

IN the December issue of the *Entomologist's Monthly Magazine* Mr. F. W. Edwards writes on the British species of Dixinæ. This subfamily includes a small number of gnat-like insects commonly regarded as constituting a family of their own. They are related both to mosquitoes (Culicidæ) and to crane-flies (Tipulidæ), and Mr. Edwards places them in the first-mentioned family. Their larvæ and pupæ are exclusively aquatic, and bear a rather close resemblance to those of Anopheles and its allies. The only genus is Dixa, which enjoys the position of never having had the validity of its name questioned, and, consequently, no synonym exists. Ten British species are recognised, but they have been so little collected that we have only a very vague idea as to their distribution in this country. In the same periodical Mr. J. E. Collin gives useful keys to the British species of the Sylvaticus group of the genus Pipunculus. Since Mr. Verrall dealt with them in his "British Flies"

(vol. viii.) further material has accumulated, rendering a revision of the genus necessary.

THE status of the rook in its relation to the farmer, fruit-grower, and forester is briefly reviewed by Dr. W. E. Collinge in the *Journal of the Ministry of Agriculture* for December. Dr. Collinge is of opinion that this bird has become too numerous, and, as a consequence of the stress of competition, it has taken to feeding upon cultivated crops. He contends that if repressive measures were put into force and carefully carried out the rook would soon assume its normal place again, and prove to be one of the most useful birds to the farmer in helping to control the larvæ of such injurious insects as click-beetles and crane-flies. The rook to-day, the author estimates, consumes about 80 tons of cereals, 32 tons of potatoes and roots, 7½ tons of insects beneficial to the farmer, and 65 tons of injurious insects, slugs, snails, etc. This last item is significant, and suggests an extension of this analysis directed to show approximately how many tons of cereals, potatoes, and roots would have been consumed by the 65 tons of injurious insects and their offspring if they had not fallen a prey to the rook.

IN No. 15 of the Economic Proceedings of the Royal Dublin Society (November, 1920) Prof. G. H. Carpenter reports on the injurious insects and other animals observed in Ireland during the years 1916–18. Among the various pests mentioned are larvæ of a species of Bibionid fly which caused much damage in wheat-fields by feeding on the roots, and those of *Bibio Marci*, L., found attacking potatoes stored in a pit. The flax flea-beetle (*Longitarsus parvulus*, F.) caused serious injury to the flax crop during the three years under review, and it was found necessary to re-sow the crop in several localities, no method of control being referred to. Storehouse beetles (*Ptinus fur*, L., and *P. tectus*, Boield.) are recorded as devouring very varied substances. Those of the first-mentioned species are believed to have been introduced from Tasmania, and were noted in 1908 in a consignment of almonds, and in 1911 from stuffed birds. Early in 1918 *P. fur* was received from Dublin localities among seeds of henbane intended for sowing, while *P. tectus* was discovered in a chemist's store of casein. The report is adequately illustrated, but shorter than many of its predecessors, which is possibly accounted for by the war and by conditions in Ireland generally.

THE first Report of the National Institute of Agricultural Botany, recently issued, shows that encouraging progress is being made with the new scheme. The aim and policy of the institute are to develop new and reselected varieties of all kinds of farm crops and to "grow on" promising types until sufficient stocks are available for distribution through the seed trade to the farmer. Liberal financial assistance has been forthcoming, not only from private benefactors, but also from the seed trade and farming industry. As the official seed-testing station is to be incorporated with the institute, a building grant and loan were obtained from the Development Commission. It is now hoped to gain new subscribers to build an adequate maintenance fund. The head-quarters of the institute, now rapidly approaching completion, are being erected at Cambridge, and include housing accommodation for a portion of the staff. The rest of the 36 acres of this site is available for trial grounds. In addition, the Hiam Farm at St. Ives (Huntingdonshire) (354 acres) will be used as a seed multiplication farm, and 39 acres of rich market-garden land at Ormskirk, Lancashire, are being developed as the potato testing station. Mr. Wilfred H. Parker has been appointed director of the National Institute, but the Seed Testing Station will retain its independence under its own director, and will be equipped to test all kinds of agricultural, garden, or forest seeds. It is hoped that the buildings will be ready for occupation by August, 1921, and arrangements are being made whereby the work of the institute will be carried on with the least possible delay.

THE possibility of a general world-wide sinking of sea-level to the extent of nearly 20 ft. during post-Glacial times is discussed by Prof. R. A. Daly in the Proceedings of the National Academy of Sciences (Washington) (vol. vi., No. 5), and at greater length in the *Geological Magazine* (vol. lvii., No. 672). Observations on coast-lines in many parts of the world show approximately this degree of emergence, and the facts appear to warrant belief in synchrony in the age of the strands. Prof. Daly, however, points out that the suggestion is published, not to express a fixed conclusion, but to invite criticism and to test the idea in different parts of the world. If this emergence is established throughout the world, its explanation cannot be found in a change in the earth's centre of gravity or in a change in its speed of rotation. Prof. Daly suggests an increase in the past in the volume of existing ice-caps as a possible explanation. He calculates that a thickening of the Antarctic ice-cap to the average amount of 700 ft. would lower the sea-level by about 20 ft. by the abstraction of water from the ocean basins.

A REPORT on two pilot-balloon ascents made at Shoeburyness by Mr. N. K. Johnson is published by the Meteorological Office as Professional Notes No. 13. Both ascents were made on February 18 last. It is claimed that the results indicate the limitations and uncertainty of the single-theodolite method of observation, while they show the accuracy obtainable in determining upper-wind velocities and directions by the double-theodolite method. The first ascent was observed for 74 minutes, and in 48 minutes had attained 26,400 ft. The balloon then apparently developed a leak, and sank continuously to 12,800 ft., when it was lost in a light bank of haze. The second ascent was started at 11.50 a.m., 85 minutes after the first ascent, and was followed for 116 minutes. The balloon rose to 32,000 ft. in 64 minutes, which is said to be in excellent agreement with the rate of ascent given by Dines's formula. It afterwards maintained a practically uniform height until the 93rd minute, and afterwards fell slowly to 27,000 ft., when it was lost to view. Both balloons

were followed by two theodolites 4290 ft. apart, and also by a range-finder. The results obtained from the range-finder are said to be very much less accurate than those given by the two theodolites, both the heights and the distances by the range-finder being consistently low by about 10 per cent.

MR. N. A. ALLEN read an interesting paper on the current density in the crater of the carbon arc to the Physical Society on December 10. By using an arc between a positive carbon and two negative carbons in the same plane, but inclined to the positive at 100°, he found that the crater was a circular plane which could be easily focussed on the screen and accurately measured. The distance between the carbons corresponded to the largest "silent" current. Ten minutes were allowed to elapse before a reading was taken, so that the crater had time to assume its normal size. Under these conditions Mr. Allen found that with a maximum inaccuracy of about 1 per cent. the area of the crater in millimetres was equal to the current in amperes multiplied by 1·34. The experiments were made with currents varying between 2·5 and 10 amperes.

A THIRTY-PAGE pamphlet on "Optical Methods in Control and Research Laboratories," just published by Messrs. A. Hilger, Ltd., will prove of great use to works physicists and chemists concerned in the determination of the refractive indices, absorptions, or optical rotatory powers of materials. As a rule, such determinations must be made on direct-reading instruments, but it is desirable that the observer should understand the principles of the instrument which he uses, and be able to tell at once when it has gone wrong and to set it right. The pamphlet contains tables of the ranges and sensibilities of the different types of instruments and gives numerous references to books and memoirs in which further information may be found.

THE October quarterly number of the Journal of the Society of Glass Technology contains an article by Dr. W. E. S. Turner on "Some Developments in the Study of Glass Technology in the Year 1919-20." Dr. Turner states that during the war this country produced chemical glass "second to none in the world so far as chemical resistance was concerned"; and that as regards optical glass, glasses superior to those produced at Jena have been made on a commercial scale in this country, and also in very great variety. If it were a question of quality only, Dr. Turner adds, then we could very reasonably hope to maintain our market intact. But the existing rates of exchange in certain foreign countries operate to the disadvantage of the industry in this country. The article reproduces the fourth annual report of the Delegacy for Glass Research, from which it appears that, besides a considerable output of research work, much has been done to resuscitate the educational work of the University of Sheffield in the department of glass technology. An appendix to the report gives a list of the researches either planned or already in progress. Many of these researches are in fields in which other scientific bodies, such as the National Physical Laboratory, the British Scientific Instrument Research Association, and the Glass Research Association, are also working. The journal contains, besides several interesting papers communicated to the society, including one by Dr. George H. Miles on "The Human Factor in Industry," a useful section of abstracts and reviews.

THE report on the heating of buried electric cables which was presented to the Institution of Electrical Engineers on December 17 is of interest to men of science as well as to engineers. The thermal problems in connection with the cables are those principally considered, and important results have been obtained. For instance, it is proved that the thermal conductivity of the paper insulation used in high-tension cables is about three times as great as that of paraffin wax and practically constant. Hence to determine the temperature of the inner cores of the cables carrying given currents all that is necessary is to determine the thermal resistance of the earth in contact with the lead sheath. The thermal conductivity of earth containing 15 per cent. of moisture was found to be five times greater than that of the paper insulation. Hence by elementary calculations it is now possible to calculate the temperature rise of cables carrying given currents when laid in certain soils. A curious result found by one of the experimenters was that a cable when buried 4 ft. under the ground heated more than when it was only buried 1 ft. Hence the cooling by air convection of the heated ground in the latter case must have been appreciable. It is of interest to notice the close connection between the problem discussed in this report and the corresponding problems in connection with the electrostatic capacity and the current-flow in cables. Kelvin pointed this out eighty years ago.

A PAPER read by Engr.-Comdr. C. J. Hawkes at the meeting of the North-East Coast Institution of Engineers and Shipbuilders on November 26 contains a great deal of information derived from experiments on the injection and combustion of fuel-oil in Diesel engines. These experiments were carried out at the Admiralty Engineering Laboratory on both the solid-injection and air-injection systems. The engine experimented upon was a single-cylinder four-stroke engine having a piston of aluminium alloy, 14½ in. diameter by 15 in. stroke, developing 100 brake-horse-power at 380 revolutions per minute. The paper is very long, and it is possible to make reference to one or two points only. One of the later tests with solid injection gave an average fuel consumption of just under 0·4 lb. per brake-horse-power per hour when developing 100 brake-horse-power at 380 revolutions per minute. The sprayer used in this test had five 0·016-in. holes, with flats, and a fuel-valve roller clearance of 0·003 in. In this test the piston had been fitted with an obturator ring, which proved beneficial. In all the tests the best all-round results were obtained from this sprayer. Taking the fuel-oils experimented with in these tests, it has been found that up to about 100 lb. per sq. in. mean indicated pressure the fuel consumption with solid injection is approximately the same as the fuel consumption with air injection at the same power and

speed after taking into account the power required to drive the injection compressor. On an i.h.p. basis the consumption is less with air injection, thus indicating that the combustion is better with air injection. Those interested in the dynamics of cam-driven valves will find much of value in the paper.

MR. D. BROWNLIE has made a survey of a large number of boiler plants, and in the *Chemical Trade Journal* for August–September he published the individual figures obtained relating to different industries. The details of the performance of sixty typical steam-boiler plants used in chemical works are tabulated, and he discusses their merits and demerits. Since these tests were not applied after careful preparation of the plants, they may be regarded as representative of normal working conditions. The true average net working efficiency for the whole sixty plants was found to be approximately 58 per cent., but the author's experience leads him to the conclusion that a modern plant run on scientific lines will give on the average 75 per cent. net working efficiency for continuous performance, a variation between 65 per cent. with purely refuse coal and 82½ per cent. with the best quality coal being approximately the limits which should exist. If the average efficiency could be raised from 58 per cent. to 75 per cent., obviously a great saving would result, amounting to 285,000*l.* per annum on the sixty plants tested. The reasons given for the low results obtained are insufficiency of grate length, economiser capacity, use of superheaters, and insulating steam-pipe covering. Other causes are that the feed-water is not properly treated to avoid scale troubles, and that the combustion processes are not chemically controlled by the use of recorders. Brickwork and foundations, too, were found in a bad state of repair, with a consequent leakage of cold air. The author criticises the use of chimney draught and steam jets when mechanical draught would serve the same purpose more economically. His great insistence, however, is on the necessity for supervision of the plant according to modern scientific methods, and he proceeds to summarise the rigid system of record-taking, which he believes to be essential if the best results are to be obtained. A number of instruments useful for control purposes are mentioned by name, but, of course, their relative merits and demerits are not subjects which the author can deal with in a single article.

Our Astronomical Column.

SKJELLERUP'S COMET.—The following observation was secured by Prof. Barnard at the Yerkes Observatory:—G.M.T. December 18d. 21h. 55·6m., R.A. 9h. 22m. 13s., S. decl. 1° 37′ 49″. The following provisional orbit was deduced from the observations of December 13, 17, and 18:

$$T = 1920 \text{ Dec. } 13{\cdot}1743 \text{ G.M.T.}$$
$$\left.\begin{aligned} \omega &= 343^\circ\ 47'\ 9'' \\ \Omega_{1920} &= 107^\circ\ 39'\ 23'' \\ i &= 23^\circ\ 53'\ 10'' \end{aligned}\right\} 1920{\cdot}0$$
$$\log q = 0{\cdot}06439$$

Ephemeris for Greenwich Midnight.

		R.A. h. m. s.	N. Decl. ° ′	log r	log Δ
Dec.	31	10 19 36	17 4	0·0776	9·4769
Jan.	4	10 34 53	22 25	0·0838	9·4972
	8	10 48 33	27 16	0·0909	9·5220
	12	10 59 58	31 29	0·0989	9·5503
	16	11 9 40	35 10	0·1075	9·5799
	20	11 17 42	38 24	0·1167	9·6115

The comet will not become conspicuous, but should be readily visible until the moon interferes with observation towards the end of January.

THE JANUARY METEORS.—Mr. Denning writes:—"The shower of Quadrantids (or Boötids, as they are sometimes called) is due to recur on the nights of January 2 and 3, and it is likely to be conspicuously visible this year if the weather is clear, for there will be no interference from moonlight. The most favourable time to observe the shower will be in the few hours preceding sunrise or in the early evening. The strength of the shower apparently varies from year to year, but its visible character is much affected by moonlight and atmospheric conditions. The meteors are often brilliant and traverse long flights. In 1918 the radiant point seemed to be 7° or 8° north of the usual position, and the display appeared to be more abundant than usual."

THE MASSES OF THE STARS.—The growth of our knowledge of stellar masses has been slow; it was for a long time limited to the very few cases of binaries the orbits and parallaxes of which were known. The next extension came through the spectroscope, which demonstrated the binary character of Algol variables and the existence of the class of spectroscopic binaries. Although the individual masses of the latter could not be found without a knowledge of the inclination, the results could be used statistically, assuming a mean inclination. One product of this research was the fact that the B stars have large masses.

The idea occurred independently to Russell and Hertzsprung that double stars showing curvature of motion could be used statistically for mass-determination even when the arc described was so short that the orbit could not be deduced. Russell concluded that B stars and giant A stars had an average mass of eight times the sun's, while the mass of the other pairs was about double the sun's.

This latter result was provisionally adopted by J. Jackson and H. H. Furner in a paper read to the Royal Astronomical Society on December 10. They utilised all available orbits of binaries, and also several hundreds of other pairs the relative motion of which showed curvature. The parallax of each pair was deduced on the assumption that its mass was double the sun's; its linear motion was then deduced from its observed proper motion.

The resulting apex of the solar motion is R.A. 273·0°, decl. +33·8°, and speed 19·13 km./sec.; the latter is so close to Campbell's spectroscopic value, 19·5 km./sec., that it fully confirms the validity of the assumption.

H. v. Zeipel, in the course of an article on stellar evolution in the December issue of *Scientia*, states that an attempt is being made at Upsala Observatory to obtain the relative masses of the giant stars of the different spectral types by a study of the grouping of these types in the globular clusters. He says: "One can demonstrate . . . that the massive stars congregate in relatively greater numbers than the light ones towards the middle of the group. By careful study of the distribution of the different types, one can deduce the mass of each." The detailed results are not given.

Education at the British Association.

FOLLOWING the presidential address (see NATURE, November 4), the Education Section opened its proceedings by receiving an interim report of the Committee on Training in Citizenship. The report should prove valuable to all who are interested in the welfare and future of their country. *Five hundred extra copies were ordered, and are obtainable by application to the Assistant Secretary, British Association, Burlington House, W.1.* It includes:—(1) A comprehensive syllabus of instruction in civics; (2) an analysis of the Scout scheme of training towards citizenship by Lt.-Gen. Sir R. Baden-Powell; (3) schemes of school management and self-government; and (4) suggestions for organising regional study, and notes of lessons in regional survey.

Bishop Welldon, who presented the report, said that training in citizenship was the chief educational interest of the day, and that he hoped a book would be issued on the lines of the syllabus with the authoritative sanction of the British Association itself.

Sir Napier Shaw, in seconding the adoption of the report, discussed the conditions that make for good citizenship, and suggested that, in the establishment of good government, only experience could guide the peoples in this matter, and that it is the business of education to enable the rising generation to profit by the experience of the past.

Mr. J. J. Clarke, of Liverpool, presented a comprehensive survey of teaching civics to adults. He defined civics as a true conception and a recognition of the incumbent duties which necessarily accompany the association of men passing beyond all question of legal contract, and forming the unseen and unforged links which bind the citizen of this vast Empire to the State. He emphasised the necessity of having teachers practically acquainted with details of their work, and inspired by high ideals and a love of the subject.

Mr. A. Patterson, of Cavendish House, contended that civics should be treated not as a special subject, not as an additional subject for the curriculum, but incidentally as part of, and as one of the chief objects in, other subjects. He urged that the teacher should be the student of civics, and hand it on transformed to the child, adapted to his range of experience and capacity. He thought that various forms of school government, and societies in which the children take an active part, are better than lessons, the children thus learning through their own experience.

The papers read before the section dealt mainly with three important aspects of educational work, viz.:—(1) The relation of schools to life; (2) methods of teaching, and the appraisement of ability in a joint meeting with the Sub-section Psychology; and (3) the place in a national system of education of universities, public schools, training colleges, and higher technical schools.

Mr. A. Linecar read a paper advocating the adoption of a general governing principle guiding all school work, such as the power of concentration of mind. All subjects become then a means to an end, and not an end in themselves—the broader the curriculum, the broader the culture; it becomes possible then to cultivate capacity, to appreciate art, literature, beauty, Nature, and nobility without struggling to attain sectional high efficiency, to give power to be happy, and the possibility of a broad, tolerant, healthy, and full mental life.

Mr. F. M. McTavish dealt with the importance of education for the adolescent, and claimed that it was through secondary education our schools are most closely related to life, for it deals with the link between childhood and manhood, and therefore on the grounds of social expediency secondary schools should be free. They only can adequately meet the need of a well-marked stage in human growth and development, the adolescent stage. Each and all must pass through it, whether their parents live in palaces or in slums, and therefore the kind of education best suited to it ought to be available for all.

In a paper on the industrial aspects of life in its relation to schools, Mr. Bray, Assistant Controller of the Training Department in the Ministry of Labour, directed attention to the importance of awakening both employers and trade unions to their responsibilities towards the youthful worker, claiming that up to the age of eighteen these young people should be treated as workers in course of training, and not as workers only. Statistics show that industry as a whole does not yet recognise the new status of the boy under the Education Act of 1918; no adequate provision has been made for trade teaching, for physical welfare, or for general training. The question is a vital one: to members of trade unions it affects the well-being of their sons; to the employers the efficiency of their future workmen. The schools have a double duty: first to educate industry itself by securing a change of attitude towards the juvenile worker through industrial problems in the upper classes of secondary schools, and secondly to assist industry in the selection and training of its entrants.

An excellent paper by Miss Strudwick reviewed in a very happy form the present position of schools in their relation to life. In it she indicated some of the many causes which prevent them from being as effective as they might be, and some of the reforms which are necessary, emphasising the need for cultivating independence of judgment, an appreciation of good literature, and a profitable use of leisure. Miss Strudwick urged the value of corporate life in schools as a means of developing a sense of responsibility, unselfishness, self-discipline, and freedom of criticism. She suggested that co-education was a more natural and wholesome way of beginning life, although there were many difficulties in the way of its being adopted universally. Her plea for a fuller recognition by the nation of the importance of a teacher's work will be endorsed by all sections of the profession—"that right relation between school and life can be attained only when two conditions are fulfilled, when to those who teach their profession is a vocation and the love and confidence of their pupils a reward beyond price, and when those who do not teach are ready to accept in their midst those who do, and to make them feel that, in the best and truest sense, they belong to the world."

In the discussions that followed the Maharaj Rana of Jhalawar and Prof. Kilpatrick, of Columbia University, took part.

A joint meeting with Section E followed to hear a paper by Prof. J. L. Myres on "The Place of Geography in a Reformed Classical Course." Prof. Myres said that the recent decisions respecting "compulsory Greek" compelled a drastic revision of classical teaching. In place of language teaching he advocated a closer co-ordination between history, literature, and geography, and suggested that the Mediterranean region was exceptionally suited to supplement, by contrast, homeland notions of geography; the ancient narrative and description in translations of man's behaviour under these conditions, and his solutions of

social and moral problems in ancient times compared with ours, would admirably serve as a foundation for a reformed classical education.

A joint meeting with the Sub-section Psychology was well supported. Prof. T. P. Nunn reviewed the present trend of thought respecting methods of teaching. He said it was generally recognised now that true learning requires the pupil to be at least an active partner in his own education, and that we have travelled far in this direction of recent years Fixed classes and fixed time-tables could not remain as they are if the individual pupil, with his distinctive powers and needs, was to be the centre of the business. Inspired by Dr. Montessori's success, courageous pioneers here and abroad are following up this revolutionary suggestion with pupils of secondary-school age.

Prof. G. H. Thompson read a paper in which he discussed the question: Do Binet-Simon tests measure general ability? He combated the conclusion based on the results obtained that the general ability evaluated by the tests was in the nature of a general common factor present in all performances.

Dr. Kimmins attracted a large audience to hear his paper on dreams of abnormal children—the deaf, blind, and crippled.

A large gathering assembled on the last morning to hear an address by the Right Hon. H. A. L. Fisher on the place of the universities in a national system of education. In Mr. Fisher's unavoidable absence the address was read by Sir Robert Blair. Mr. Fisher referred to the "general influence which universities exercise in promoting a spirit of liberal inquiry as opposed to that rigid and exclusive system of dogma which centuries ago was the product of intolerant clericalism, and is now, in modern democratic societies, preached by revolutionary or class-conscious sects." "If it be the cardinal requirement of our modern civilisation that a career should be open to talent, then it follows that universities should play a much larger part in the life of the people than historical accidents have hitherto assigned to them." He described how this enlargement was going on even before the war, and how greatly it had been increased as a result of it. In his own opinion the Government scheme of grants, whereby more than 25,000 ex-Service men are now undergoing some form of higher education in our universities and colleges, is destined to exert a permanent influence over the history of university development in these islands. In addition, our universities will be swollen by a further influx of students who otherwise before the war would have gone to Berlin or Vienna. The Education Acts of 1902 and 1918 are providing another source of recruitment through grants for secondary and continuation schools. Mr. Fisher pointed out how the work at the universities was held up for lack of funds, and hoped that private munificence will help to supplement and increase the comparatively moderate grant which the State is able to provide. A great addition to the teaching body of this country is imperatively demanded by the circumstances of the time, and he urged that the quality of the education which is to be given to the rising generations will depend upon the extent to which the universities are enabled to leave their impress upon the teachers of our schools.

Mr. Frank Fletcher, headmaster of Charterhouse, followed with a paper on "The Public Schools in a National System of Education." Public schools at the present time could scarcely be said to form a part of a national system, but Mr. Fletcher argued that the question of this relationship has been raised by the Teachers (Superannuation) Act of 1918. A considerable number of public schools were unable, out of their own resources, to provide a satisfactory pension scheme; they would therefore be compelled to seek Government assistance, which would entail conditions linking them up with the national system. He claimed that no reflections of a derogatory character should apply to those who did ask for State assistance, and that those schools standing out should not be excluded from opportunities of rendering services to the State in direct connection with the national system. The form which this service might take (he said) was tentatively put forward by Mr. Fisher:—(1) That the public school should receive boys from county secondary schools the numbers of which were too small to allow of more than one type of education being given, and yet in which might be one or two boys of promise whose bent did not coincide with that of the school; (2) co-operation in the training of teachers and in the inspection of secondary schools. Mr. Fletcher urged the big public schools to accept inspection by the Board of Education rather than that of the universities, so that inspectors of the smaller secondary schools should have experience of the organisations of the larger type. Such service could be rendered without losing that individuality which was the essence of their existence. The inspectorate would then act as a clearing-house of ideas between all types of schools, and each would learn from the other and the Board from both.

Mr. J. C. Maxwell Garnett described by means of a colour diagram sixteen different types of education, showing their interrelationship, and especially the position of the higher technical schools, in what he hoped would be a national system established in the course of the next ten years.

Miss Wodehurst (Bristol University) submitted a paper on training colleges in a national system of education, and argued that there was still a need for the two-year-trained teachers as against the three- or four-year university student. She urged the desirability of keeping the entrance to the teaching profession sufficiently wide to admit those who were unable to obtain full-time courses of study, and showed that there were many sound and valuable reasons why the training colleges were better able to provide for the two-year student than the universities, especially for those who would have charge of children under twelve years of age. It is well known that capacity to profit by a training college experience extends far beyond those who can reach matriculation standard. The universities of the future could meet this need only by lowering their standards of entrance, not only for attainment, but also for ability; hence the use of the non-university college, with a staff of university-trained specialists and a governing body containing university representatives.

One afternoon was devoted to the question of the supply of teachers. An interesting discussion followed an admirable paper by Mr. Spurley Hey on the present shortage of teachers in elementary schools. The reasons for the shortage Mr. Hey attributed to three causes:—(1) The failure of the Board of Education's policy in throwing over the pupil teachers centres and depending on the secondary school to supply recruits; (2) the failure of the Local Education Authority generally to realise the importance of taking steps to maintain an adequate supply of teachers; (3) the hostile and unsympathetic attitude of the teaching staff towards the L.E.A. in creating a supply. Mr. Hey pointed out how the Board had already taken steps to remedy this serious state of affairs by (1) its pension scheme; (2) additional grants for the payment of better salaries; (3) the establishment of the Burnham Committee; (4) providing avenues of approach to the teaching profession other than through the secondary school; (5) impressing upon the L.E.A. the need for immediate action towards

creating an adequate supply; and he urged the Board to further action by providing more generously towards the preliminary education and training of teachers by exacting severe financial penalties on the defaulting L.E.A., and by amending the Teachers (Superannuation) Act so as to allow teachers to accept important educational administrative posts without loss of pensionable service. He suggested that recruits are more likely to come forward when the L.E.A. is prepared to regard existing teachers less as paid employees and more as colleagues in carrying on the educational service, and to give teachers a place in consultative and administrative work through the medium of advisory or Whitley committees, or through membership of education committees. He finally pleaded that teachers should abandon their unsympathetic attitude, and that the profession should unite in endeavours for its own expansion and improvement in the interests of education generally.

An afternoon was occupied in hearing a paper by Dr. Vincent Naser and discussing the organisation of international intellectual relations. A committee was formed to deal with the proposals brought forward. The report of the committee upon the educational value of museums was taken on the third afternoon, and the last one was spent in a very interesting and enjoyable visit to the summer school at Barry.

Agriculture at the British Association.

THE papers read at the Agricultural Section covered a wide field, and included several of special horticultural interest. The section was well supported by the workers attached to the agricultural departments at Bangor and Aberystwyth, who contributed a considerable proportion of the papers. The attendance from other parts of the country was, unfortunately, rather smaller than usual.

Following the presidential address, Mr. H. V. Taylor (Ministry of Agriculture) read an important paper on "The Distribution of Wart Disease in Potatoes." This disease appears to have been recognised by Newstead so far back as 1878, but the present serious outbreak dates from about 1898, when specimens of infected tubers were brought to the notice of Sutton's by Kerr, of Dumfries. For a considerable number of years the areas infected by the disease were comparatively small in extent, and limited practically to Lancashire, Cheshire, Staffordshire, and the south of Scotland. Since then the disease has spread with great rapidity, and is now found in all areas north and west of a line from Newcastle to Bristol. The north-east of Scotland, however, is still quite clear. The disease is most prevalent in industrial areas, where potatoes are repeatedly grown on the same ground and where there is a less frequent change of seed. The use of infected seed is the most probable cause of the spread of the disease, and the difficulties of transport in the last two or three years have led to less frequent changes of seed and to the use of seed from infected areas. The fact that certain of the newer varieties of potatoes are very susceptible to the disease has doubtless not been without influence.

By 1910 it was known that certain varieties were immune to the disease, and in 1914 experiments were begun at Ormskirk to ascertain definitely which varieties were immune. In 1918 the trade was invited to send in varieties to be tested, and the number under inspection greatly increased. The results of these investigations have been to show that certain varieties, such as Great Scott, King George V., Majestic, Kerr's Pink, Tinwald Perfection, Arran Comrade, Golden Wonder, Langworth, etc., were immune to the disease. The distribution of seed from infected areas is now controlled by the Agricultural Departments of England and Scotland, and the planting in infected areas confined to immune varieties. Serious problems were involved in the administration necessary to secure adequate control, but by the energetic action of the Departments of Agriculture the difficulties are being largely overcome. The magnitude of the task involved will be realised when it is stated that some 37,500 acres of potatoes in Scotland and about 10,000 acres in England were inspected this autumn to ascertain their trueness of type.

Mr. F. J. Chittenden contributed a paper on "The Experimental Error in Potato Trials," describing a series of experiments which had been carried out at the Experimental Gardens of the Royal Horticultural Society at Wisley in Surrey. The paper dealt first with the various factors which influenced the yield so far as they are known at present, special attention being directed to the conditions under which the seed is grown and kept and to the treatment which it receives previous to planting. It was shown that in carefully conducted experiments when forty plants were taken the experimental error was not more than ±5 per cent.

Two very suggestive papers were contributed respectively by Messrs. T. Whitehead and C. L. Walton, of University College, Bangor, on "A Preliminary Report on the Parasitic Fungi of North Wales" and "The Agricultural Zoology of North Wales." Mr. Whitehead has made a survey of the chief fungoid diseases attacking the cereal and root crops of the four northern counties, while Mr. Walton has commenced an investigation into the entomological and parasitological troubles of the farmer and stockbreeder, and in particular into certain diseases affecting sheep. The work in both cases has scarcely got beyond its initial stages, but promises to yield useful results.

Capt. R. Wellington, of the Ministry of Agriculture, gave the results of "An Orchard Survey of the West of England," while Mr. R. G. Hatton described the investigations which had been carried out on fruit-tree stocks at the Experimental Station, East Malling, since 1912. Mr. Hatton pointed out that the trade had long since discarded even the obvious dividing lines of vigour and growth characters, let alone the precise distinctions of species. The first work, therefore, was that of classification, and stocks of far greater uniformity than was available in the past are now at the disposal of future investigators.

Mr. S. P. Wiltshire described the methods of infection of apple-trees by *Nectria ditissima*, Tul., and the various preventive methods of treatment which had been tried.

Prof. T. Wibberley gave an account of his experiments on "Intensive Corn-Growing" in Ireland which he has been carrying on for the past ten years. He advocated the sowing of oats very early, immediately after the ground was cleared of the first crop; at the end of September the crop was cut several times or grazed, and then manured in the spring. In this way it was claimed that heavier crops could be grown without danger of their being laid.

An important paper on "The Artificial Production of Vigorous Trees by Hybridisation" was read by Prof. A. Henry; the full paper has since been pub-

lished in the *Quarterly Journal of Forestry* (vol. xiv., 1920, p. 253).

The joint discussion with the Botanical Section on "Plant and Soil Survey Work" brought forward an interesting group of papers on both the chemical and botanical sides. Mr. G. W. Robinson (Bangor) described the results of his soil survey work in North Wales, and showed that attempts to classify the soils according to the geological formation from which they were derived had proved unsatisfactory. This was partly due to large areas having been obscured by glacial drifts, and also to the fact that, even in the case of soils derived from the underlying rock, the variety of soil types is by no means so great as that of rock types.

The soils have been classified into twelve types, four of which are composed of soils mainly derived *in situ* from the underlying rock, while the other types include transported soils such as drifts and alluvia.

Mr. E. A. Fisher dealt with the important question of soil acidity, and suggested doubts as to the trustworthiness of the ordinary methods for determining the "lime requirements" of a soil.

Prof. R. G. Stapledon described his "Surveys of Grassland Districts"; while Miss W. H. Wortham gave a summary of the results of a botanical survey of North Carnarvonshire and Anglesey.

Sir Daniel Hall, Messrs. C. G. T. Morison, T. J. Jenkin, C. T. Gimmingham, and R. Alun Roberts, Miss E. N. Miles-Thomas, and others took part in the discussion which followed. Sir Daniel Hall said that there did not always appear to be a clear conception as to the object of the work. He suggested the simplification of methods, if possible, and a closer attention to the economic side of the question.

From the discussion two points emerged: (1) The soil chemists were quite agreed that the time had come for a revision of the methods of soil sampling and analysis at present in use, and it was felt that it was not desirable to embark on any extensive new work before this was done. (2) It was evident that there was need for a much closer co-operation between the soil chemist and the plant ecologist, both in planning survey work and in carrying it out. This is more true of England than of Scotland.

It was resolved to appoint a joint committee representing plant ecologists and soil chemists to consider and report on the whole question.

At the closing meeting Mr. G. S. Robertson described the results of his most recent investigations on manuring with ground rock-phosphates. He referred to the increasing demand for phosphates both at home and abroad and to the difficulty of maintaining the supply of superphosphates and slag. The experiments showed that ground mineral phosphates gave results which compared very favourably with the returns given by the old basic Bessemer slags.

Amongst the other papers read were "Experiments on Green Manuring," by H. J. Page; "The Sugar-Content of Straw," by S. Hoare Collins; and "The Varieties of Oats," by C. B. V. Marquand.

ALEXANDER LAUDER.

Studies of Heredity.

MR. C. C. LITTLE has studied (*Journal of Genetics*, vol. viii., 1919, pp. 279–90) colour inheritance in cats, with special reference to black, yellow, and tortoiseshell, and gives an explanation—not a very easy one—of the rare occurrence of tortoiseshell males which may be either sterile or fertile. The genetic constitution of the normal colour varieties of cats as regards yellow and black pigmentation appears to be as follows: B=a factor producing black pigmentation, Y=a factor which restricts black from the coat, and *y*=a factor allelomorphic to Y and hypostatic to it, allowing black pigment to extend to the coat. Mr. Little also discusses (*Science*, vol. li., 1920, pp. 467–68) a curious case in the Japanese waltzing mouse of hereditary susceptibility to a transplantable tumour. He concludes provisionally that from three to five factors—probably four—are involved in determining susceptibility to the mouse sarcoma; that for susceptibility the simultaneous presence of these factors is necessary; that none of these factors is carried in the sex (×) chromosome; and that these factors Mendelise independently of one another. In another paper (*Amer. Naturalist*, vol. liv., 1920, pp. 267–70) the same investigator criticises Dunn's suggestion that there is a linkage between the genes for yellow and for black in mice, and shows that the facts may be explained by assuming that yellow, when present, hampers the action of a lethal factor in much the same sort of way that it hampers the activity of the black-forming factor in the skin and hair. In a note on "Some Factors Influencing the Human Sex-Ratio" (Proc. Soc. Exper. Biol. and Medicine, vol. xvi., 1919, pp. 127–30) Mr. Little concludes: (1) That a significant excess of males is observed in the progeny of human matings involving racial crosses as compared with matings within the race; (2) that racial crosses between the European races studied (Italian and Spanish) will produce in the first hybrid generation a significant excess of males (which will be economically important to the United States); and (3) that there are significantly fewer stillbirths among the progeny of the hybrid matings studied than among the pure matings. In another paper (*Amer. Naturalist*, vol. liv., 1920, pp. 162–75) Mr. Little deals with exceptional colour-classes in doves and canaries. These have been explained on the hypotheses of "partial sex-linkage" and "non-disjunction," but the author thinks it is more legitimate to suppose a factorial change from one gene to its allelomorph, perhaps as the effect of "intergenic and intra-cellular environment." In a note on the origin of piebald spotting in dogs (*Journal of Heredity*, vol. xi., 1920, pp. 1–4, 3 figs.) Mr. Little deals with two cases in dogs which give direct evidence as to the origin of spotted individuals, and suggests that a spotted race may arise from a self-race, by mutation, without passing through a series of minute gradations directed by selection.

Dr. C. B. Davenport (Proc. Nat. Acad. Science, vol. iv., pp. 213–14) deals with an hereditary tendency to form nerve-tumours (multiple neurofibromatosis). Proliferations of the connective tissue-sheaths of nerves result in numerous sessile or pedunculate swellings. The course of the disease, which is rare, is influenced by metabolic changes in the body. There is sometimes an associated production of pigmented spots in the skin. There is evidence that the disease may occur in successive generations, and that it behaves as if it were a dominant, occurring in about 50 per cent. of each affected fraternity. "The fact that neurofibromata have an inheritable basis strengthens the view that cancers in general have such a basis." In another paper (*Journal of Heredity*, vol. x., 1919, pp. 382–84) Dr. Davenport reports a case of a Cleveland family where a tendency to multiple births has appeared in each of four successive

generations. We have also received Dr. Davenport's annual report as director of the department of experimental evolution and of the eugenics record office of the Carnegie Institution of Washington. It gives us a glimpse of a manifold activity. Investigations are in progress on the modifiability of the germ-plasm by alcohol, the control of sex in pigeons, the sex-intergrades in Daphnia, the heredity of colour in dogs, cats, doves, and canaries, heredity in aristogenic families, inbreeding in man, and many other subjects.

The Pan-Pacific Scientific Conference.

THE first meeting of the Pan-Pacific Scientific Conference was held at Honolulu on August 2–20. At the close of the meeting a number of general resolutions were passed which concerned the conference as a whole. It was resolved that similar conferences should be held at intervals of not more than three years, and that the Governor of Hawaii should be invited to take action to make the conference a permanent organisation. Other resolutions dealt with the desirability of establishing an International Research Council, and with the need for the equipment of ships by the Governments concerned for the purpose of carrying out scientific research in the Pacific Ocean. The last general resolution was concerned with the promotion of education and with the need for the better payment of scientific workers; this was dealt with more fully in NATURE of October 21, p. 249.

The sections of the meeting have also published a number of recommendations. The section of anthropology advocates measures which are similar to those urged by Prof. Karl Pearson in his presidential address to Section H (Anthropology) of the British Association at the meeting this year at Cardiff. It recommends that centres for study and research in anthropology should be developed by the expansion of university departments or by the alliance of universities with other research institutions, so that such schools may combine all the features of museums and of research and teaching institutions. Research is particularly necessary into the history and culture of the Polynesians in order to reach a satisfactory solution of the ethnological problems of the Pacific.

The resolutions of the section of biological science can be divided into three groups; the first deals entirely with marine biological survey in the Pacific. It is contended that the work should be undertaken by the Governments of those countries bordering on the Pacific Ocean, and that steps should be taken to avoid the overlapping of work which might otherwise occur. The second group of recommendations deals with the land fauna of the Pacific islands. A survey of the fauna, and particularly of the mollusca, on both the better-known and the comparatively unknown islands in the Pacific is advocated. The last group of recommendations deals with the flora of Polynesia. Surveys are again necessary, and attention is directed to the importance of investigating carefully the flora of new lava-flows.

Surveys are also the burden of the recommendations of the geographical section. Topographical maps of many land areas in the Pacific are incomplete, and surveys of the shore-line and coastal waters are necessary. Continued work is also necessary in order to complete the general magnetic survey of the Pacific Ocean, and to extend this work to coastal waters where the magnetic phenomena are known to be complex. Recommendations dealing with physical oceanography merely emphasise those put forward by the biological section when referring to marine biology; the two ends could be served by the same expedition. Meteorology is also included in the scope of the section on geography. Observation at the place of origin of typhoons, cyclones, etc., and of the motion of these disturbances is necessary, and the establishment of an observatory on the Island of Hawaii and the resumption of observations at Macquarie Island are advocated. In most cases it is urged, on the plea of expense, that the work should be undertaken by the States bordering on the Pacific.

The section dealing with geology passed a number of resolutions advocating extensive geological surveys in the Pacific area. It recommends that three maps on the international scale of 1 : 1,000,000 should be drawn, one showing topographical features, another geological formations, and the third mineral resources. Another important group of recommendations deals with the importance of subaerial and submarine erosion, and asserts the need for research on the geological side of these matters. A plea was also made for the planning of research in such a way as to correlate the efforts of different workers and to promote a uniform mode of publication of results.

Three motives, the need for localised work, for publication and for the education of people in providing safeguards against disaster, and for precise geophysics, were the basis of the resolutions passed by the section on seismology and vulcanology. The section recommends the establishment of more volcano observatories, and also the intensive study of earthquakes in seismic provinces as likely to lead to advances in geophysical knowledge. It also advocates that complete statistics of earthquakes and eruptions for the whole world should be compiled. This project could be furthered by the establishment of a central bureau for the Pacific which could collect and disseminate information of a seismological nature, and later the same scheme could be applied to the world. An important resolution was that dealing with the training of people in proper methods of construction and in behaviour during emergencies in countries liable to seismic disaster.

Polynesia is to be congratulated on having successfully gathered together her men of science in an endeavour to increase our knowledge of the Pacific Ocean and of the conditions existing in the archipelagoes of that side of the world.

Mathematics in Secondary Education.

BULLETIN No. 1 (1920), recently issued by the U.S. Bureau of Education, shows that the authorities at Washington are fully alive to the difficulty of the problems that confront the secondary schools in this era of reconstruction. It contains, under the heading "The Problem of Mathematics in Secondary Schools," a report of a committee which confesses at the outset that it has been unable to come to definitive conclusions. The committee has therefore contented itself with throwing out suggestions based upon an analysis of the existing situation in the hope that the result will be such a series of discussions and experiments as will enable future committees eventually to arrive at definite proposals for reconstruction.

At the outset the present state of affairs is acknowledged to be entirely unsatisfactory. Traditions are

to go by the board, and the admission of a subject to the curriculum must be based upon its value in relation to the conditions of social welfare. Not only mathematics, but all subjects, are to be reviewed and revalued. The psychologist has come upon the scene. The uncritical belief of the past in "mental discipline" is challenged. The general recognition of individual differences and the growing practice of differentiation and adaptation afford additional reasons for a close examination of the usual courses, and side by side with this problem is that of the courses best adapted for average mortals and for those who will proceed to an advanced stage of study.

As for the method of presentation, the report emphatically condemns the old divorce from reality. The ideas and the interests of the pupils must be utilised as the environment in which the mathematical conception is to find its natural setting. The existence of the conception within the *milieu* provides the necessary stimulus for its utilisation. The ideas and interests of the pupil provide it with projects and problems to which it desires solutions. The instruments for this purpose are to be found in the concepts. The "instrumentally selected content" must be free of all that will destroy potential interest, and will make an end of the watertight compartments into which our subject has so long been divided. With this instrumental basis of selection and procedure it is possible for all to begin together. But the future specialist will already, as he proceeds, be more attracted than the average student by the mathematical relationships, and find pabulum for thought in the mathematical instrument itself and in the assumptions which in the earlier stages he has taken for granted as natural. The place for the fully developed logical system is not here as yet, nor will it be found in the work of the future engineer, who will be content with the mathematics which is required in the projects and problems of a preliminary engineering course.

Definition is likewise required of the demarcation between the practical and the cultural or "interpretative" use of mathematics, and here must also be defined the groups which require enough to meet their social demands and individual aptitudes. These groups must necessarily overlap. The content of the course in all cases must be decided by a preliminary study of the irreducible minimum, and that is obtained by the rigid exclusion of all material of which the specific value for the definite purpose cannot be fully shown. The proposals do not differ in any very marked degree from the conclusions of, say, the Committee of the Mathematical Association, which some years ago drew up a tentative course for average students and for future specialists. There is in this bulletin much that is worth quoting. Conditions of space limit us to the following passage, which, though it contains nothing new, is nevertheless very true, and its teaching cannot be too strongly impressed upon the minds of teachers, especially upon those of the young and enthusiastic.

"Teachers . . . only too frequently deceive themselves as to the place that the presentation of a rigorously logical proof plays in bringing conviction. The worth of a sense of logical cogency can hardly be overestimated; but we who teach not infrequently overreach ourselves in our zeal for it. The teacher of introductory mathematics can well take lessons from the laboratory, where careful measurement repeated under many different conditions will bring a conviction often otherwise unknown to the pupil who is not gifted in abstract thinking. Probably in most instances an inductively reached conviction is the best provocative of an appetite for a yet more thorough-going proof."

There is one further point that should be noticed: the resentment on the part of American secondary schools at the attempts of the colleges to dictate the contents of their courses. Any restriction placed upon the free play of discussion and experiment is strongly deprecated.

University and Educational Intelligence.

LONDON.—A lecture on "Some Considerations on Tonus and Reflexes" will be given at the Royal Society of Medicine (1 Wimpole Street, W.1) by Prof. J. K. A. Wertheim Salomonson, professor of neurology in the University of Amsterdam, at 5 p.m. on Monday, January 17. This lecture has been arranged under a scheme for the exchange of lecturers in medicine between England and Holland. Five other Dutch lecturers will also give one lecture each, particulars of which will be announced later. A course of eight lectures on "The Physiology of the Embryo, Fœtus, and Newly-born" will be given by Prof. M. S. Pembrey in the Physiological Theatre, Guy's Hospital, at 4.30 p.m. on Thursdays, January 13, 20, and 27, February 3, 10, 17, and 24, and March 3. Admission to these lectures is free, without ticket.

SIR LEONARD ROGERS has been appointed Stuart Mill lecturer in tropical medicine at the London (Royal Free Hospital) School of Medicine for Women, and Miss Dorothy Maughan lecturer in pharmacy.

IN connection with Somerville College, Oxford, a Mary Somerville research fellowship of the value of 250*l*. for three years will be offered in March next. Particulars may be obtained from Miss M. F. Moor, Old Headington, Oxford.

APPLICATIONS are invited by the Senate of the University of London for the Graham scholarship in pathology, value 400*l*. per annum for two years, and tenable at University College Hospital, Gower Street, W.C.1. Particulars are obtainable *personally* from the professor of pathology at the college. Applications for the scholarship must be sent to reach the Principal Officer, University of London, South Kensington, S.W.7, by the first post of Monday, January 17, 1921, marked "Graham Scholarship."

ON December 20 Mr. J. H. Gardiner, representing Messrs. James Powell and Sons (Whitefriars), Ltd., in company with Mr. P. Annett, divisional organising officer for the Middlesex Education Committee, made a visit to Greenhill, Drill Hall, and Harrow Weald Council Schools, and addressed the boys who, having reached the age of fourteen, were upon the point of leaving school. The object was to interest the boys in the glass industry and to suggest to them the possibilities of good employment in the glassworks that are now being erected at Wealdstone. The boys, having been told the character of the work and the prospects that it holds out to them to learn one of the most important trades in the country, were invited to attend a series of evening continuation classes during the coming term, when a syllabus has been arranged to give them a thorough grounding in English, arithmetic, the metric system, physical manipulation (woodwork, etc.), freehand drawing, and elementary chemistry and physics. After attending the classes a selection will be made of the most promising boys, who will then pass through a special course of technical lectures in glass, its chemistry and properties. After this they will be drafted into the works, where a special laboratory is being fitted

up in which for a certain number of hours a day they will learn the rudiments of the many branches of the industry. During the remaining portion of the day they will be employed in making themselves useful in one or other of the many departments of the firm. The speed at which they will learn their business will depend upon their own efforts, aided by all the assistance that can be given to them in the way of instruction.

An interesting pamphlet has been published by the Universities Bureau of the British Empire, 50 Russell Square, London, W.C.1, containing lists of the students and teachers from our Colonies and from foreign countries who are studying in or attached to the universities of Great Britain. It is a record of the large-scale hospitality which is extended by our centres of learning to students of all nationalities. India sends us by far the largest number of students; including those from Burma and Ceylon, there are as many as 665 Indian students at present being educated in this country, of whom 292 are at London University and 125 and 67 respectively at Cambridge and Oxford. South Africa sends a large contingent, which is divided among the same universities roughly in equal numbers. Canada and Australia also have students in Great Britain, of whom the greater number are at Oxford; the totals for these Dominions are 123 and 121 respectively. Of foreign countries the United States is the largest contributor; 329 students in all are over here, of which 193 are at Oxford, 68 at London, and the remainder are distributed between Cambridge and the provincial universities. The subjects which have the greatest attraction for both Colonial and foreign students appear to be economics and medicine. It is also interesting to note that there are 56 Serbian and 66 Russian students studying in our universities at the present time.

At a recent meeting of the trustees of the General Education Board of the Rockefeller Foundation grants amounting to 20,251,000 dollars were made to ninety-eight colleges and universities for general education and for the development of medical schools. Of this sum 12,851,666 dollars will be given as an endowment to provide increases in teachers' salaries, provided that the institutions themselves succeed in raising for the same purpose a sum of 30,613,334 dollars. Medical schools will benefit to the following extent:—1,250,000 dollars for endowment and 70,000 dollars for additional laboratory facilities to Washington University Medical School, St. Louis; 1,000,000 dollars for the endowment funds of Yale Medical School; 300,000 dollars for improving the facilities in obstetrics and 350,000 dollars for the development of the teaching of psychiatry in Harvard Medical School; and 400,000 dollars for the development of a new department of pathology in the Johns Hopkins Medical School. For the furtherance of general medical research 1,000,000 dollars has been alloted to the Medical Research Foundation of Elizabeth, Queen of the Belgians, Brussels. Other grants were made for a number of educational purposes, 287,350 dollars for co-operation between State universities and State Departments of Education in the Southern States of America in the fields of secondary and rural education, and 500,000 dollars for endowment and 443,500 dollars for current expenses and equipment of negro schools. A grant of 15,000 dollars has also been made to the American Conference on Hospital Service for the purpose of establishing a library and a service bureau, and one of 25,000 dollars to the National Committee for Mental Hygiene (U.S.) to enable it to carry out surveys on the care and treatment of mental diseases during the year 1920.

Calendar of Scientific Pioneers.

January 1, 1748. John Bernoulli died.—Born at Basle in 1667, he shares with his brother James the credit of developing the infinitesimal calculus, their mastery of which was acknowledged by Leibniz.

January 1, 1817. Martin Heinrich Klaproth died.—The first chemist in Germany to adopt Lavoisier's views, he became in 1809 the first professor of chemistry in the newly created University of Berlin.

January 1, 1894. Heinrich Rudolf Hertz died.—Hertz, who was born in Hamburg, February 22, 1857, went to Berlin in 1878, and later became an assistant to Helmholtz. At Kiel in 1883 he studied Maxwell's work, and afterwards at Karlsruhe gave the first experimental verification of Maxwell's electromagnetic theory of light. The Hertzian waves used in wireless communication are of the same nature as those of light, but of much greater wave-length and with a wider range. Hertz died at the age of thirty-seven, soon after he had discovered how to produce and detect these waves, but the later development of wireless signalling is based upon his fundamental work.

January 2, 1816. Louis Bernard Guyton de Morveau died.—By profession a lawyer, Morveau devoted his leisure to chemistry, and in 1787, with Fourcroy, Berthollet, and Lavoisier, published the important work "Méthode de Nomenclature Chimique."

January 3, 1640/41. Jeremiah Horrocks died.—While a curate at Hoole, in Lancashire, Horrocks at the age of twenty-two calculated and observed for the first time a transit of Venus. This he saw on November 24, 1639. Within fourteen months of his great achievement he died suddenly at Toxteth. The interest aroused by the transit of 1874 led to a memorial to Horrocks being placed in Westminster Abbey in 1879.

January 3, 1908. Charles Augustus Young died.—One of the most energetic of American astronomers, especially in spectroscopic work.

January 4, 1882. John William Draper died.—Chemist, physiologist, and historical and philosophical writer, Draper obtained in 1839 the first portrait by the daguerreotype process, and in 1840 the first photograph of the moon. Born near Liverpool on May 5, 1811, he emigrated to America, and assisted to found, and served as president of, the New York Medical School. His "History of the Intellectual Development of Europe" appeared in 1862. Henry Draper (1837–82), the astronomer, was his son.

January 4, 1906. Charles Jasper Joly died.—Born at Tullamore in 1864, Joly in 1897 became Astronomer-Royal of Ireland.

January 5, 1904. Karl Alfred von Zittel died.—Educated at Heidelberg, Paris, and Vienna, in 1863, when twenty-four, Zittel became professor of mineralogy at Karlsruhe, and three years later succeeded Oppel at Munich. Widely known for his writings, such as his "Handbook of Palæontology" and his "History of Geology and Palæontology to the End of the Nineteenth Century," he was president of the Royal Bavarian Academy of Sciences and a Wollaston medallist of the Geological Society.

January 5, 1913. Louis Paul Cailletet died.—A student at the Paris School of Mines, Cailletet's first researches related to metallurgy. Later work led him to study gases under pressure, and in 1877 he succeeded in liquefying oxygen. A like result was obtained at about the same time by Pictet at Geneva. Cailletet, who was a member of the Paris Academy of Sciences, was in 1910, at his academic jubilee, referred to as "the father of modern cryogenics."

E. C. S.

Societies and Academies.

PARIS.

Academy of Sciences, December 6.—M. Henri Deslandres in the chair.—G. **Lemoine**: The mutual reaction of oxalic and iodic acids: the influence of heat and dilution. Oxalic acid in aqueous solution is slowly oxidised by iodic acid to carbon dioxide, iodine being set free. The reaction is a slow one and well suited for the study of its velocity. Diagrams of the effects of dilution and temperature are given.—P. **Termier** and W. **Kilian**: The overlapping fragment at Mont Jovet (Tarentaise): the glistening schists to the north of Bourg-Saint-Maurice. This fragment is shown to have come neither from the north-west nor from the west; its probable origin is from the east or the south-east, and appears to have been carried from the Briançon layer.—A. **de Gramont**: Table of lines of high sensibility of the elements, arranged for analytical work. A table of wave-lengths for use in the spectroscopical detection of the elements in analytical work. The most prominent and the most persistent lines are given, both for eye observation and for photography with uviol and with quartz prisms.—M. **Laubeuf**: The application of the Pitot tube to the measurement of the velocity of ships. M. Mesnager has recently commented on a note on this subject by the late M. Yves Delage. A note on the same subject was communicated to the Academy so far back as 1901 by MM. Raverot and Belly, and the apparatus there described has been tested on three French ships. It was found to be impossible to correct on theoretical grounds for the numerous sources of error, and the instrument had to be calibrated by running over measured distances and drawing a curve giving the relations between the readings of the instrument and the actual velocities.—G. **Dumas** and J. **Chuard**: The homologies of Poincaré.—P. **Humbert**: Laplace's equation in hypertoroidal co-ordinates.—A. **Egnell**: Congruences of right lines the mean surface of which is a given surface.—B. **de Fontviolant**: Calculation of the strengths of bridges.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the third quarter of 1920. The observations made on eighty-one days during the quarter are classified in three tables, showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—A. **Danjon**: A relation between the light of the eclipsed moon and solar activity. The luminosity of the eclipsed moon is known to vary. Adopting a scale of 5° of brightness, this has been plotted against the date of the eclipse. The resulting curve rises from one solar minimum to the next, with a sudden fall at each minimum. The passage through a maximum of solar activity is marked by no peculiarity.—P. **Menard**: A reversible mercury manometer with damped oscillations.—A. **Pérard**: The interference method for the determination of quartz standards of length. A description of the modified Michelson method employed, in which any silvering of the surfaces of the standard is avoided, and a table showing the refractive indices of two standards for wave-lengths between 435·8 $\mu\mu$ and 643·8 $\mu\mu$.—G. **Ribaud**: Wide continuous absorption bands of light.—L. **de Broglie**: The absorption of the Röntgen rays by matter.—F. **Brocq**: A general method of continuous electrical integration.—A. **Damiens**: The subiodide of tellurium, TeI_2. Contribution to the study of the system iodine-tellurium. A curve of the melting points of mixtures of iodine and tellurium is given. The only definite compound appears to be TeI_4; no substance TeI_2 exists, the mixture having that composition being a mixture of the tetraiodide and a solid solution of tellurium and tetraiodide. Both thermal and metallographic analyses lead to the same conclusion.—M. **Barlot**: A complex combination of thallium and hydrofluoric acid. The double fluoride H_2TlF_3 has been isolated. The thallium can be precipitated by the usual reagents, but the solution gives no precipitate with the usual reagents, such as calcium salts, and does not attack glass, although strongly acid to indicators.—M. **Geloso**: The reduction of permanganate by arsenious acid.—G. **Mignonac**: The catalytic hydrogenation of hydrobenzamide. Method for the preparation of benzylamine. From a study of the reduction of hydrobenzamide in alcoholic solution by hydrogen in presence of nickel, it would appear that the addition product described by O. Fischer is not formed; the products are benzylamine, benzalbenzylamine, and ammonia.—P. **Robin**: The oxidation of arisaldoxim: the peroxide of arisaldoxim.—A. **Mailhe** and F. **de Godon**: The preparation of the methyl derivatives of the xylidines and naphthylamines by catalysis.—L. **Bertrand**: The mode of formation of the Pyrenean strata.—F. **Gomez-Llucea**: The geology of Cabrera, Conejera, and other neighbouring islands.—P. T. **de Chardin**: The succession of the mammalian fauna in the lower European Eocene.—H. **Joly** and N. **Laux**: The fauna of the lower layers of the Aalenian of the Grand Duchy of Luxembourg.—A. **Boutaric**: The variation of nocturnal radiation during clear nights. The intensity of the nocturnal radiation during clear nights passes through a maximum shortly after sunset, and then decreases slowly and regularly until dawn.—H. **Courtonne**: The opposed action of soluble chlorides and sulphates on starchy materials. A saturated solution of magnesium chloride rapidly and completely converts, in the cold, starchy matter into soluble starch. Magnesium sulphate exerts a contrary action and prevents the formation of soluble starch in solutions heated in closed vessels to 115° C.—W. **Kopaczewski**: The mechanism of the Bordet-Wassermann reaction.—A. **Lumière** and H. **Couturier**: The shock produced by the introduction of insoluble substances into the circulation. The injection of barium sulphate suspended in an artificial isotonic serum into the carotid of a dog caused the typical symptoms of anaphylactic shock.—A. **Bach** and B. **Sbarsky**: The estimation of the degradation products of proteid materials in blood serum. The reducing ferment of milk may be utilised for the detection and estimation of small quantities of degradation products of proteids.—MM. **Desgrez, Guillemard**, and **Savès**: The purification of air contaminated with certain toxic gases. A solution containing sodium sulphide and soap when used in the form of a fine spray has been found to be capable of removing chloropicrin, chlorine, phosgene, methyl chloroformates, acrolein, bromoacetone, cyanogen chloride, and benzyl iodide, bromide, and chloride. Various mixtures were tried, but none proved to be capable of such general application as the above.—M. **Kohn-Abrest**: General method for the detection and estimation of arsenic.

SYDNEY.

Royal Society of New South Wales, November 3.—Mr. James Nangle, president, in the chair.—J. H. **Maiden**: A new Angophora. A mallee-like species recorded so far from Northbridge on the north, and from Kogarah on the south, of Port Jackson. It has been passed over as a petiolate- and more lanceolate-leaved form of *A. cordifolia*, DC., but it is smaller in all its parts, less hispid, the inflorescence less corymbose, and with the differences between the juvenile and mature leaves more accentuated.—J. H. **Maiden**: Three new species

of Eucalyptus. The author has previously expressed the opinion that important results are awaiting those who more thoroughly investigate trees attributed to existing forms instead of giving too much attention to the search for rare and bizarre forms. This paper directly illustrates this point, and the following New South Wales trees are proposed as new. All yield valuable timbers:—(*a*) The Blue Mountains mahogany, attributed without doubt to *Eucalyptus resinifera*, Benth., for so many years, has pale-coloured, fissile timber very sharply different from that species. (*b*) The tall grey gum of the counties of Gloucester and Durham, hitherto named *E. punctata*, var. *grandiflora*, and therefore assumed to have a deep red timber, turns out to have pale-coloured, tough timber allied to that of the spotted gum (*E. maculata*, Hook.). (*c*) Less was known of this tree, the type of which comes from Wyee, north of Gosford. It is a grey gum with a deep red-coloured timber, possessing botanical characters intermediate between *E. longifolia*, Link and Otto (woolly-butt), and *E. punctata*, DC., the best known of our grey gums.—L. A. **Cotton** and Miss M. **Peart**: The calculation of the refractive index in random sections of minerals. The method employed is a graphical one, in which use is made of the stereographic projection. Both refractive indices for any given mineral section can be calculated when the form and position of the indicatrix are known. The principle is simple, and has been applied by Miss Peart to the evaluation of the refractive indices of the plagioclase felspars for cleavage flakes parallel to the (010) and (001) crystallographic forms.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings, vol. vi., No. 4), April, 1920.—N. L. **Bowen**: Differentiation by deformation. The deformation of an igneous mass during crystallisation, with consequent separation of liquid from crystals, has frequently been suggested as a cause of variation of igneous rocks, and this suggestion is here discussed in considerable detail under the headings of discontinuous differentiation, monomineralic types as members of composite intrusives, monomineralic types as simple "intrusives," complementary dykes, primary banding, and alkaline rocks.—T. H. **Morgan**, A. H. **Sturtevant**, and C. B. **Bridges**: The evidence for the linear order of the genes.—C. W. **Metz**: The arrangement of genes in *Drosophila virilis*. Two papers in continuation of the discussion of the linear *versus* spatial arrangement of the genes.—G. W. **Stewart**: The functions of intensity and phase in the binaural location of pure tones. With frequencies of 100 to 1200 d.v., phase is the chief factor in localisation with pure tones, the intensity effect being practically *nil*, or at least very small.—L. T. E. **Thompson**, C. N. **Hickman**, and N. **Riffolt**: The measurement of small time-intervals and some applications, principally ballistic. A description of a new apparatus for indicating very small intervals of time with application to the ballistics of small arms.—H. H. **Sheldon**: Charcoal activation. The variations due to heat treatment may be explained by assuming that the structure of the charcoal is modified or that the air was the agent causing the variations. Data are given and interpreted on the basis of the latter assumption.—J. K. **Whittemore**: The starting of a ship. A discussion with simple integral equations of the problem of a particle moving under the action of tangential forces dependent on the velocity alone, with suggested applications to marine engineering and to the study of the laws of liquid resistance.—F. L. **Hitchcock**: A thermodynamic study of electrolytic solutions. The adoption of Gibbs's principle of chemical potential leads to the extension of the ordinary theories of melting point, heat potential, and mass law. These extensions are the result of the presence in the expression of the chemical potential of the solvent for the terms in the second and higher powers of the concentrations.—I. W. **Bailey**: The formation of the cell-plate in the cambium of the higher plants. Continuation of a previous paper indicating that the type of cell-plate formation there described is of frequent occurrence, and promises to be significant in any general discussion concerning the dynamics of cytokinesis and karyokinesis.—I. A. **Barnett**: Functionals invariant under one-parameter continuous groups of transformations in the space of continuous functions. Examples of one-parameter continuous groups are given, with in each case a functional invariant in terms of which each invariant of the group is expressible.—H. **Shapley**: Thermokinetics of *Liometopum apiculatum*, Mayr. A curve is obtained relating the speed of these ants to the temperature. The speed is less erratic at higher temperatures, and increases over a 30° C. range from 0·44 cm. to 6·60 cm. per second.—J. **Loeb**: The influence of ions on the osmotic pressure of solutions. A summary and discussion of an extensive series of experiments. At lower concentrations of the electrolyte the influence of the anion increases more rapidly with increasing concentration of the electrolyte than the depressing effect of the cation, while at higher concentrations the reverse occurs. The turning point lies for a number of electrolytes at a molecular concentration of about $m/256$.—D. H. **Tennent**: Evidence on the nature of nuclear activity. The basophilic bodies are not in the nature of chromidia, but are the result of indirect nuclear activity. The explanation offered for the formation of the basophilic extra-nuclear bodies described is intended to be suggestive rather than conclusive.—A. C. **Hardy**: A study of the persistence of vision. Measurement of the persistence of vision for several colours within a cone the semi-vertical angle of which is about 40°.—R. **Pearl**: A contribution of genetics to the practical breeding of dairy cattle. A summary of investigations extending over many years with respect to the value of 224 Jersey Registry of Merit sires in relation to their transmitting qualities in milk-production. This work gives the breeder information of a sort that he has never had before, and that enables him at once to form a real judgment of the worth of various bulls which appear in the pedigree of Jersey cattle.

(Proceedings, vol. vi., No. 5), May, 1920.—H. H. **Laughlin**: Calculating ancestral influence in man. The problem is that of measuring ancestral influence by tracing chromosomes. By applying principles of combination and chance, the probability that a given complex situation will result from a given set of constituent conditions may be formulated mathematically. The formulæ here given are foundational, and are stated in general terms the validity of which depends upon their presenting correct mathematical pictures of chromosomal processes which work out in the germ-cell cycle.—G. **Medes** and J. F. **McClendon**: The effect of anæsthetics on living cells. An attempt to determine the effect of different anæsthetics on several activities or properties of living cells. Not all anæsthetics had the same effect, and the same anæsthetic affected the same activity of a plant differently from an animal, and different activities of the same cell differently. All the anæsthetics tried increased plant-cell respiration and permeability.—R. A. **Daly**: A general sinking of sea-level in recent times. The facts at hand seem to permit belief in the synchrony of the different strand-markings and emergences here considered, but further investigation is needed.—C. C. **Little**: A note on the human sex ratio. A brief study

of data collected at the Sloane Maternity Hospital in New York City.—O. **Blackwood**: The existence of homogeneous groups of large ions. It is found that for ionisation from spray and from hot wires the gradation in the size of the ions is continuous, as the mobility curves do not show sharp, separated peaks. The conclusion favours the hypothesis of Sir J. J. Thomson.—E. J. **Cohn**: The relation between the isoelectric point of a globulin and its solubility and acid-combining capacity in salt solution. A detailed discussion of the effect of sodium chloride upon the solubility of tuberin and the effect upon its acid-combining capacity.—H. P. **Armsby**, J. A. **Fries**, and W. W. **Braman**: The carbon dioxide : heat ratio in cattle. Within a range of 5 to 27 grams of feed per kg. live-weight a simple equation may be used for computing the (CO_2 : heat) ratio when the live-weight and the amount of feed consumed are known. Thus the heat production may be computed from the observed CO_2 production.—H. S. **Vandiver**: Kummer's memoir of 1857 concerning Fermat's last theorem. It is shown that the proofs given by Kummer are inaccurate and incomplete in several respects.—D. L. **Webster**: An improved form of high-tension direct-current apparatus. A description of an improvement in apparatus previously described.—R. W. **Glazer**: The effect of the concentration of nitrates on the reducing powers of bacteria. A number of species of micro-organisms were tested in Witte's peptone media containing various molecular concentrations of $NaNO_3$ and KNO_3.

Books Received.

The National Physical Laboratory. Collected Researches. Vol. xiv., 1920. Pp. iv+308+plates. (London: H.M. Stationery Office.) 25s. net.

Annual Report of the Board of Regents of the Smithsonian Institution, Showing the Operations, Expenditure, and Condition of the Institution for the Year ending June 30, 1918. (Publication 2540.) Pp. xii+612+plates. (Washington: Government Printing Office.)

Smithsonian Institution. United States National Museum. Bulletin 109. Contributions to a History of American State Geological and Natural History Surveys. Edited by G. P. Merrill. Pp. xviii+540+37 plates. (Washington: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. lxxi., No. 1. Smithsonian Physical Tables. (Publication 2530.) Seventh revised edition prepared by F. E. Fowle. Pp. xlvi+450. (Washington: Smithsonian Institution.)

Diary of Societies.

SATURDAY, JANUARY 1.

ANNUAL CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College, Gower Street), at 10.30 a.m.—A Joint Conference on The Use of Psycho-analysis in Education.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. Arthur Thomson: The Haunts of Life: The Open Sea (Juvenile Lectures).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Lecture.

MONDAY, JANUARY 3.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—F. Kingdon Ward: The Travels of a Plant-Collector on the Borders of China (Christmas Lecture).

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Discussion: Professional Questions.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—C. A. Richardson: The New Materialism.

SOCIETY OF CHEMICAL INDUSTRY (at Chemical Society), at 8.—G. H. Thurston: The Smith Continuous System of Carbonisation.—Dr. I. Masson and T. L. McEwan: (1) The Recovery of Solvent Vapours from Air. Part I., The Use of Cresol for Ether-Alcohol; Part II., The Use of Sulphuric Acid for Ether-Alcohol. (2) The Analysis of Liquid and Gaseous Mixtures of Ether, Alcohol, and Water.

TUESDAY, JANUARY 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. Arthur Thomson: The Haunts of Life: The Great Deeps (Juvenile Lectures).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—N. E. Luboshez: The Results of the Demonstration of Portraiture by Artificial Light of October 5, 1920.

MATHEMATICAL ASSOCIATION (Annual Meeting) (at London Day Training College).—Prof. A. S. Eddington: Relativity.—Dr. S. Brodetsky: Aeroplane Mathematics.—The Rev. S. H. Clarke: The Teaching of Mathematics to Boys whose Chief Interests are Non-Mathematical.—Prof. E. T. Whittaker: Some Unsolved Questions and Topics for Research.—Miss E. M. Read: Results of Visits Paid to Lycées of Paris and other Centres, and the Study of Education there, particularly from the point of view of Mathematics.

THE ASSOCIATION OF SCIENCE TEACHERS (at University College).—Miss M. B. Thomas: Presidential Address.—Dr. J. C. Drummond: Vitamines.

WEDNESDAY, JANUARY 5.

ROYAL SOCIETY OF ARTS, at 3.

PHYSICAL SOCIETY AND OPTICAL SOCIETY'S EXHIBITION (at Imperial College of Science), from 3 to 10. At 4.—Sir W. H. Bragg: Sounds in Nature. At 8.—Prof. A. Barr: The Optophone.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. S. H. Reynolds: The Lithological Succession of the Carboniferous Limestone (Avonian) in the Avon Section at Clifton.—Miss E. Bolton: The Carboniferous Limestone of the Wickwar-Chipping Sodbury Area (Gloucestershire).

THURSDAY, JANUARY 6.

ROYAL SOCIETY OF ARTS, at 3.—Sir Frederick Bridge: The Cries of London which Children heard in Shakespeare's Time (Juvenile Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. Arthur Thomson: The Haunts of Life: The Freshwaters (Juvenile Lectures).

PHYSICAL SOCIETY AND OPTICAL SOCIETY'S EXHIBITION (at Imperial College of Science), from 3 to 10. At 4.—Prof. A. Barr: The Optophone. At 8.—C. R. Darling: Some Unusual Surface Tension Phenomena.

FRIDAY, JANUARY 7.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Lt.-Col. C. Smith: Life on the Gilgit Frontier (Christmas Lecture).

SATURDAY, JANUARY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. Arthur Thomson: The Haunts of Life: The Conquest of the Land (Juvenile Lectures).

CONTENTS.

	PAGE
The Nile, Egypt, and the Sudan	557
Poynting's Scientific Papers. By Sir J. J. Thomson, O.M., F.R.S.	559
Scottish County Geographies. By Prof. J. W. Gregory, F.R.S.	561
Conifers	563
Physiology for Students and Practitioners	563
Our Bookshelf	564
Letters to the Editor:—	
The British Association.—Prof. Arthur Smithells, F.R.S.	565
Science and Fisheries.—Prof. W. C. McIntosh, F.R.S.; Henry G. Maurice, C.B.	565
Propagation of a Finite Number of Waves.—A. Mallock, F.R.S.	567
Solar Variation and the Weather.—L. C. W. Bonacina	567
Name for the Positive Nucleus.—Dr. E. B. R. Prideaux	567
The Physical Meaning of Spherical Aberration.—L. C. Martin	567
Man and the Scottish Fauna. (*Illustrated.*)	568
Some Problems of Lubrication. By W. B. Hardy, F.R.S.	569
Obituary:—	
Prof. Italo Giglioli. By Dr. E. J. Russell, F.R.S.	573
Dr. C. A. Sadler	573
Notes	574
Our Astronomical Column:—	
Skjellerup's Comet	578
The January Meteors	578
The Masses of the Stars	578
Education at the British Association	579
Agriculture at the British Association. By Dr. Alexander Lauder	581
Studies of Heredity	582
The Pan-Pacific Scientific Conference	583
Mathematics in Secondary Education	583
University and Educational Intelligence	584
Calendar of Scientific Pioneers	585
Societies and Academies	586
Books Received	588
Diary of Societies	588

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557
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559
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